16

- For DACs, monitor the impacts of projects and management actions on communities and drinking water users. For example, provide locations of the improperly constructed or abandoned wells, as discussed in Section 6.5, that create conduits for migration of poor-quality water from shallow water-bearing units into the principal aquifers. Discuss how sealing these wells will benefit DACs and domestic wells users.

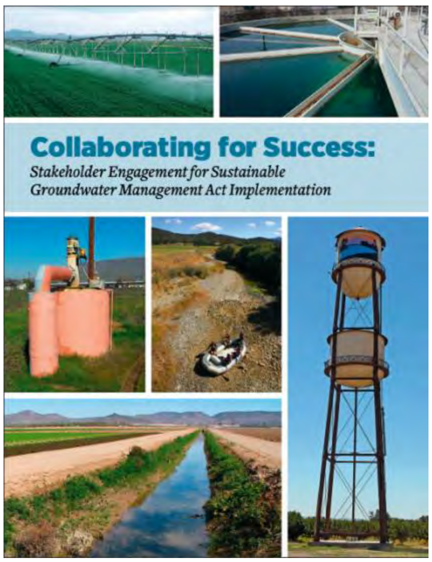
- For DACs and domestic well owners, take a full accounting of the locations and screened intervals of domestic wells in the basin, even those with de minimus use. Implement a drinking water well mitigation program to protect drinking water users.

- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

Stakeholder Engagement and Outreach



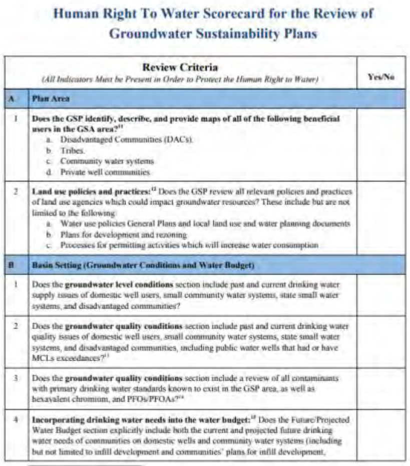
Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.

- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.

- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

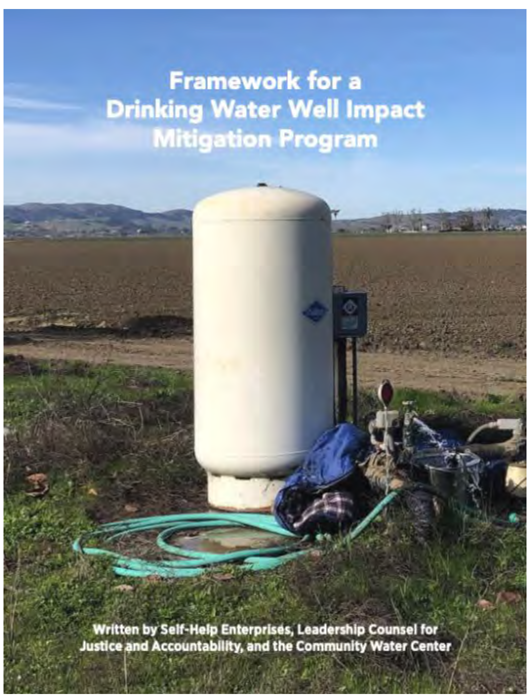


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

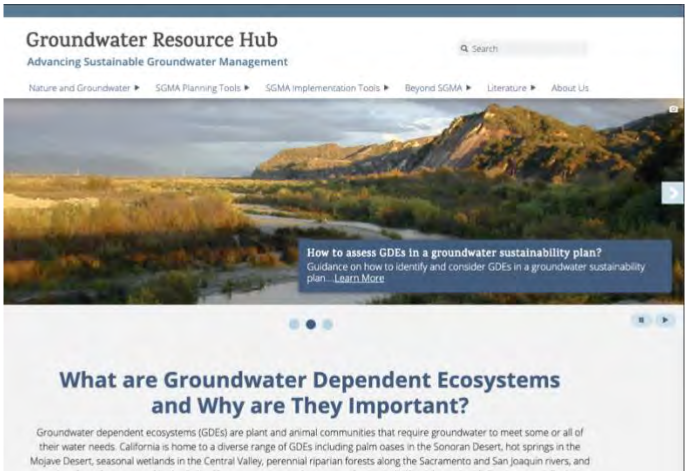
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



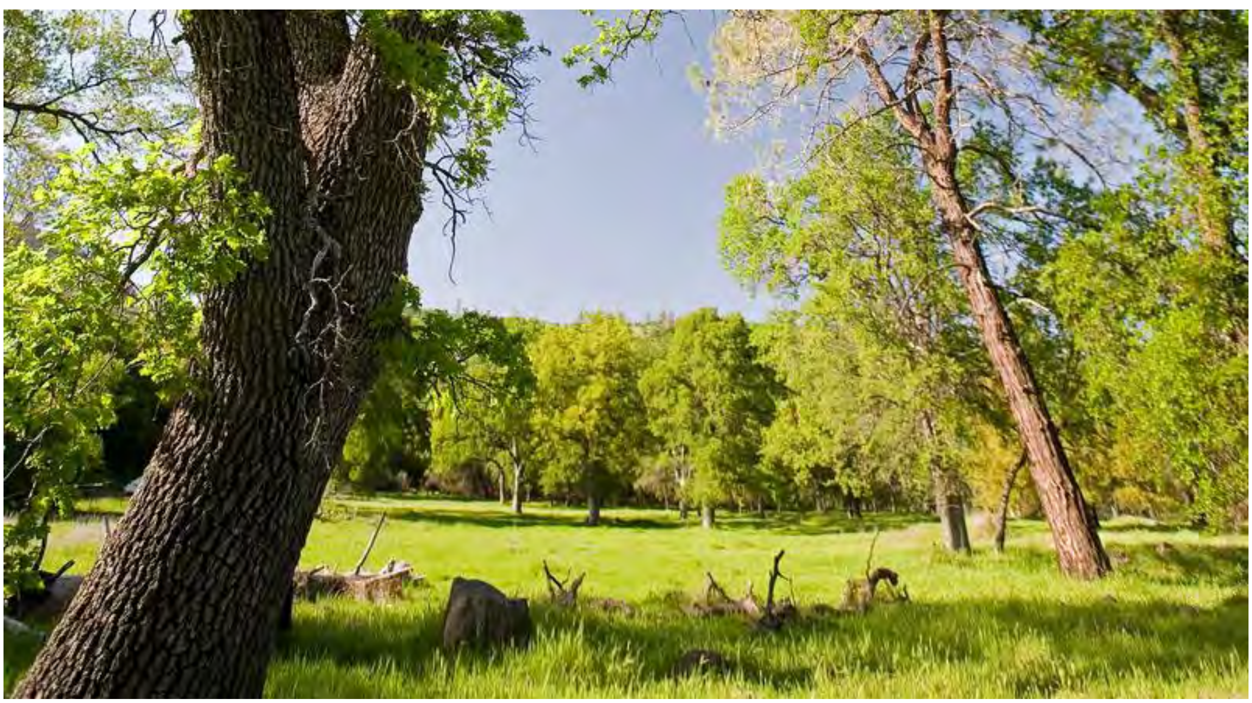
The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

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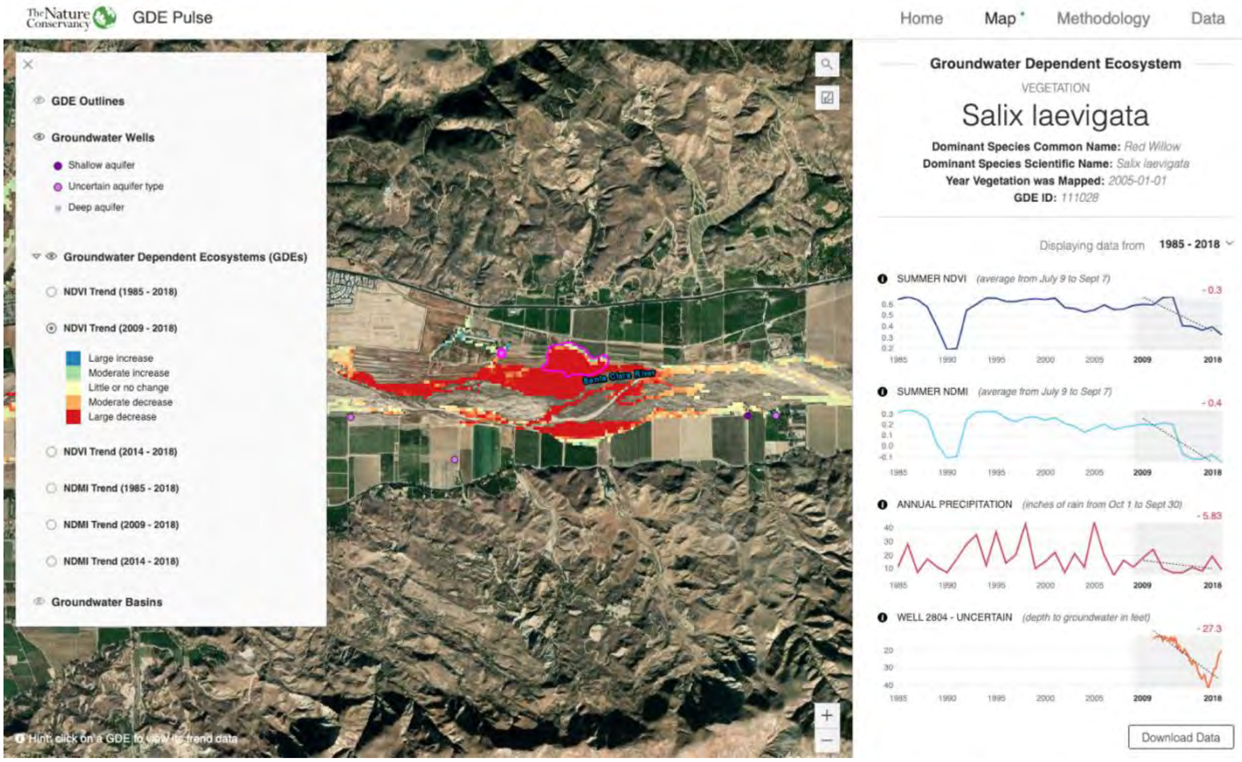
[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

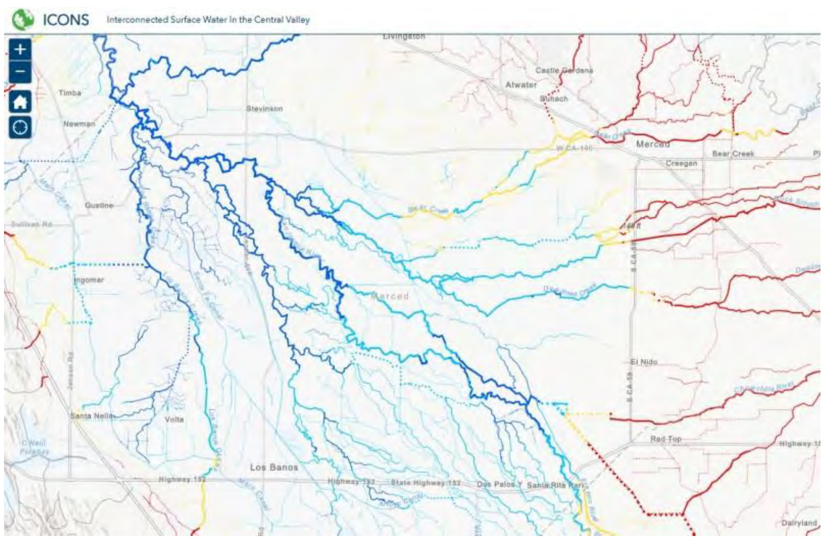
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



[ICONS](#) maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the Mound Basin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", this attachment provides a list of freshwater species located in the Mound Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	State	Other
BIRDS				
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			
Aythya americana	Redhead		Special Concern	BSSC - Third priority

[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chlidonias niger	Black Tern		Special Concern	BSSC - Second priority
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Cygnus columbianus	Tundra Swan			
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Himantopus mexicanus	Black-necked Stilt			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Ixobrychus exilis hesperis	Western Least Bittern		Special Concern	BSSC - Second priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			

Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Phalaropus tricolor	Wilson's Phalarope			
Piranga rubra	Summer Tanager		Special Concern	BSSC - First priority
Plegadis chihi	White-faced Ibis		Watch list	
Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Riparia riparia	Bank Swallow		Threatened	
Rynchops niger	Black Skimmer			
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Vireo bellii	Bell's Vireo			
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
CRUSTACEANS				
Hyalella spp.	Hyalella spp.			
FISH				
Eucyclogobius newberryi	Tidewater goby	Endangered	Special Concern	Vulnerable - Moyle 2013
Oncorhynchus mykiss - Southern CA	Southern California steelhead	Endangered	Special Concern	Endangered - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Pseudacris cadaverina	California Treefrog			ARSSC
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC

Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
INSECTS & OTHER INVERTS				
Apedilum spp.	Apedilum spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Cricotopus spp.	Cricotopus spp.			
Dicrotendipes spp.	Dicrotendipes spp.			
Enochrus carinatus				Not on any status lists
Ephydridae fam.	Ephydridae fam.			
Eukiefferiella spp.	Eukiefferiella spp.			
Micropsectra spp.	Micropsectra spp.			
Paracladopelma spp.	Paracladopelma spp.			
Parametriocnemus spp.	Parametriocnemus spp.			
Pentaneura spp.	Pentaneura spp.			
Polypedilum spp.	Polypedilum spp.			
Pseudochironomus spp.	Pseudochironomus spp.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Simulium donovani				Not on any status lists
Simulium spp.	Simulium spp.			
Simulium tescorum				Not on any status lists
MOLLUSKS				
Physa spp.	Physa spp.			
Physella cooperi	Olive Physa			V
PLANTS				
Arundo donax	NA			
Bolboschoenus maritimus paludosus	NA			Not on any status lists
Datisca glomerata	Durango Root			
Ludwigia peploides peploides	NA			Not on any status lists
Lythrum californicum	California Loosestrife			
Phyla nodiflora	Common Frog-fruit			

Platanus racemosa	California Sycamore			
Potentilla anserina pacifica				Not on any status lists
Salix lasiandra lasiandra				Not on any status lists

Attachment D

July 2019

IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

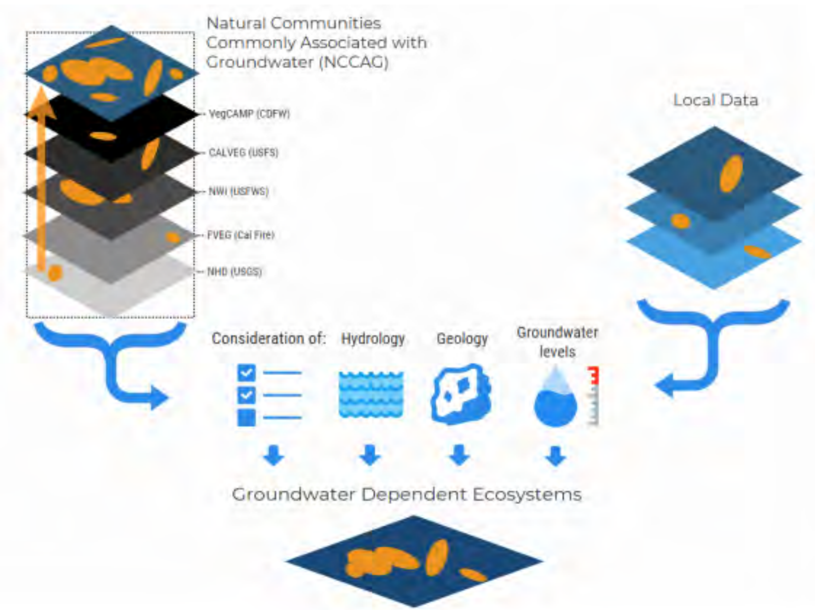


Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

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[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

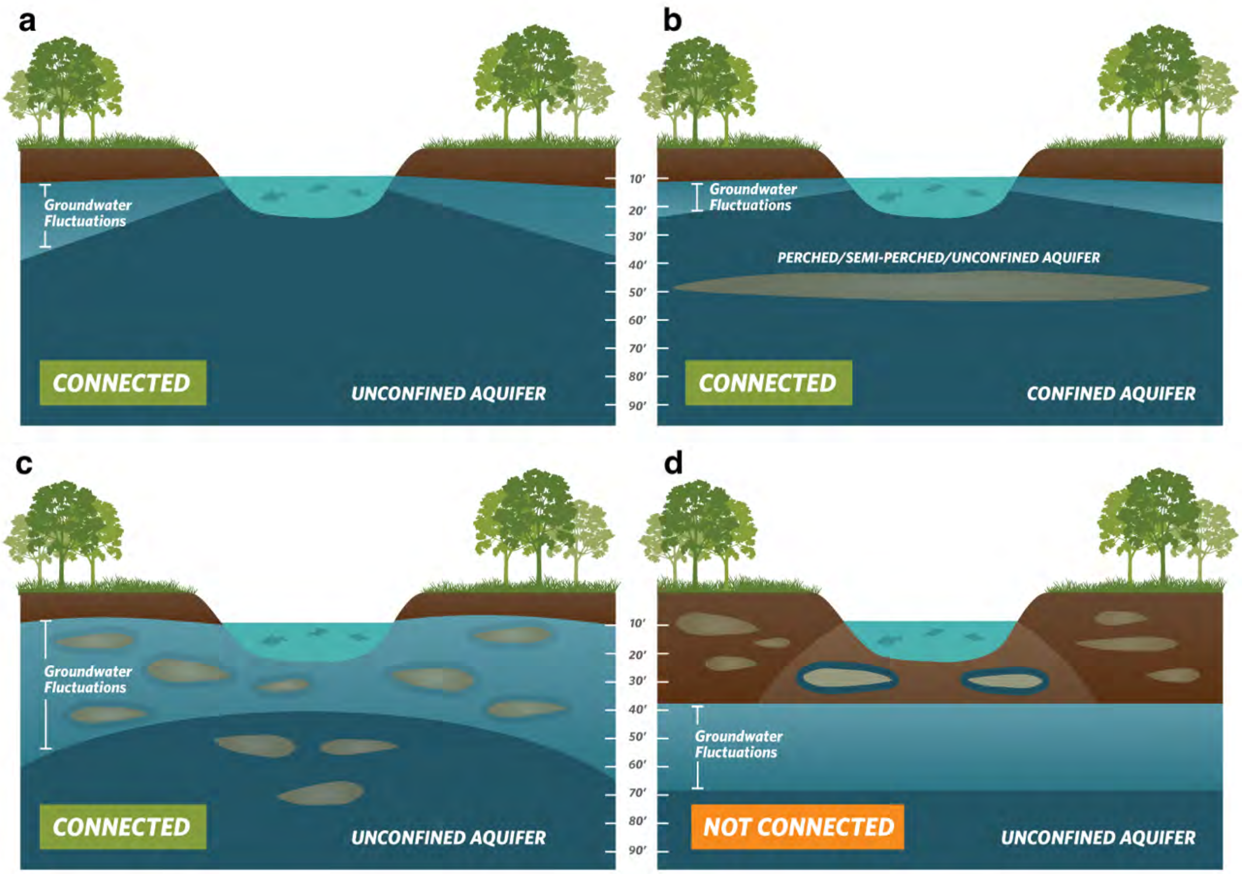

Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP <u>until</u> data gaps are reconciled in the monitoring network (see Best Practice #6).

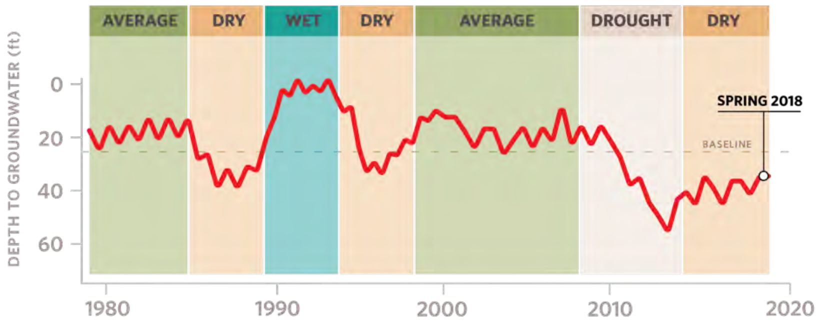

Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

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[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

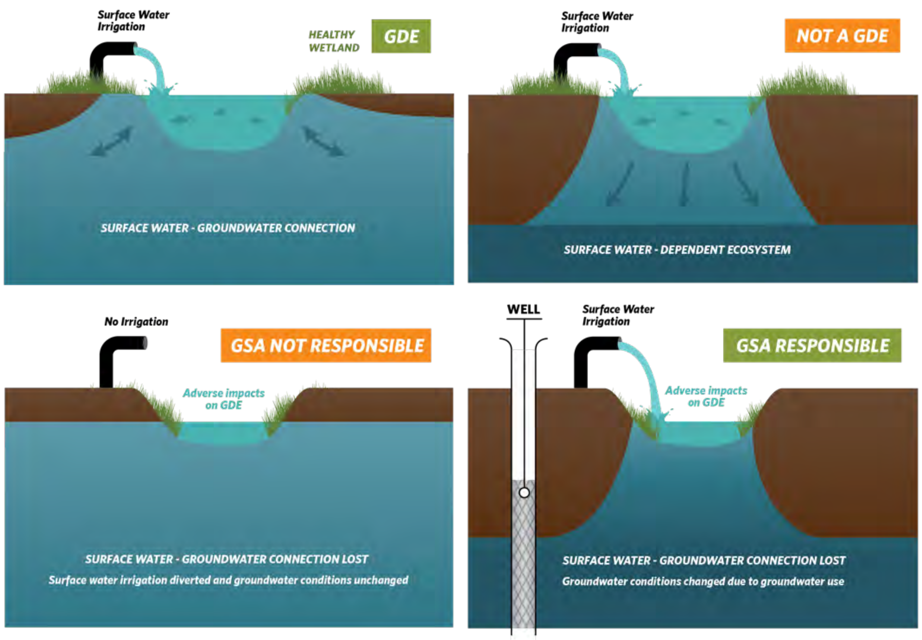

Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

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[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

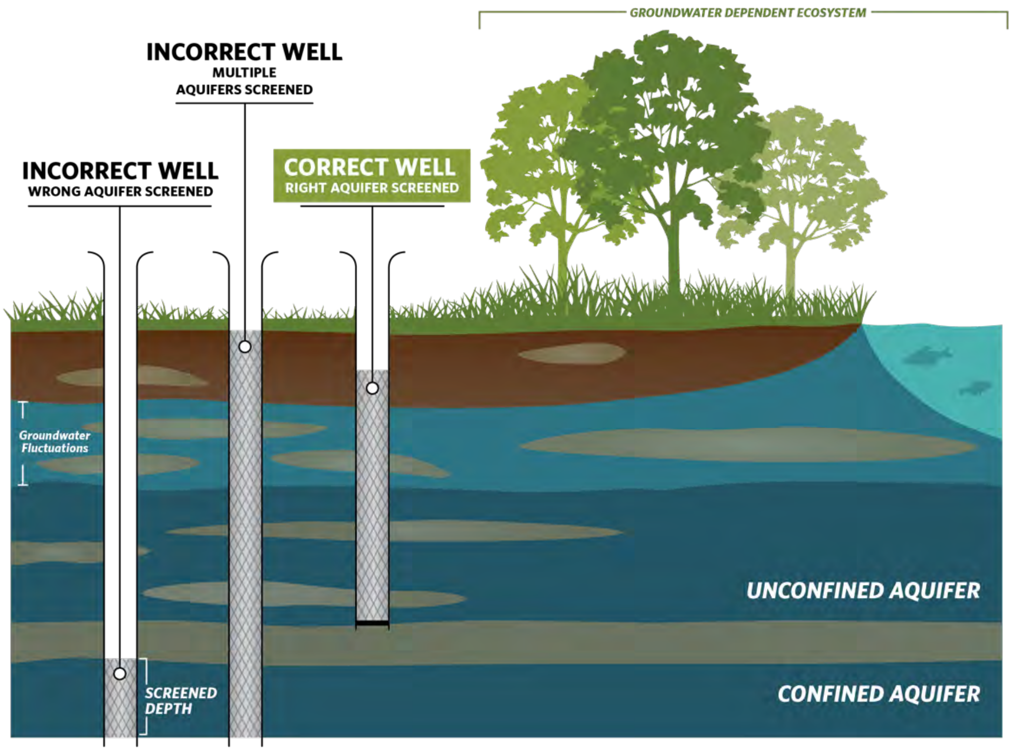

Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

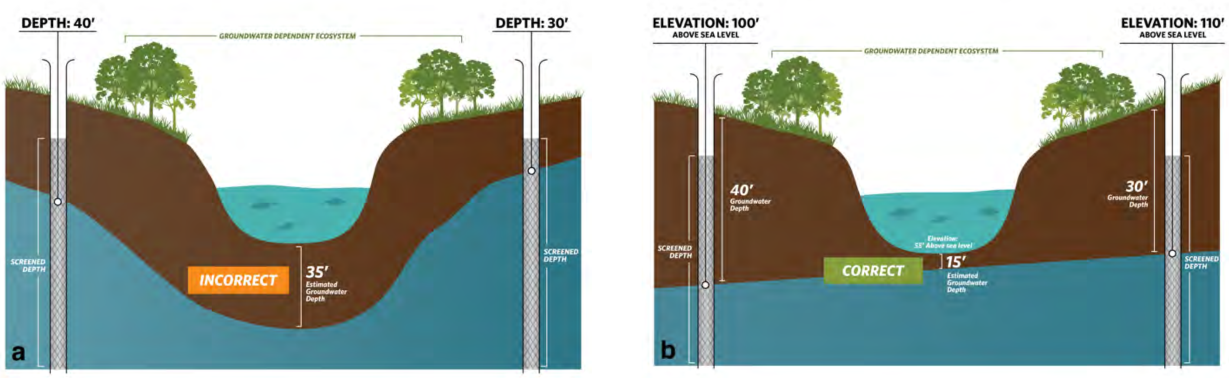

Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

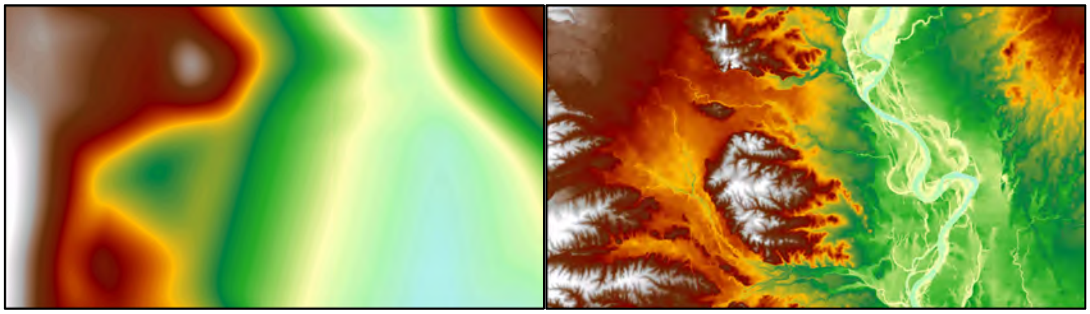

Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

August 23, 2021

Bryan Bondy
Executive Director
Mound Basin Groundwater Sustainability Agency
P.O. Box 3544
Ventura, CA 93006-3544

Re: Preliminary Draft Mound Basin Groundwater Sustainability Plan (July 2021)

Dear Mr. Bondy:

Enclosed with this letter are NOAA National Marine Fisheries Service's (NMFS) comments on the Preliminary Draft Mound Basin Groundwater Sustainability Plan (Draft GSP) prepared by the Mound Basin Groundwater Sustainability Agency (MBGSA).

The Draft GSP was developed pursuant to, and intended to meet the requirements of the California Sustainable Groundwater Management Act (SGMA). The SMGA includes specific requirements to identify and consider adverse impacts on all recognized beneficial uses of groundwater and related interconnected surface waters, including Groundwater Dependent Ecosystems (GDE). (*See* Cal. Water Code §§ 10720.1, 10721, 10727.2.)

As explained more fully in the enclosure, the Draft GSP does not, but should, adequately address the recognized instream beneficial uses of the lower Santa Clara River and Santa Clara River Estuary (as well as other GDE), potentially affected by the management of groundwater within the Mound Groundwater Basin. Additionally, the Draft GSP should also recognize the important relationship between the extensive groundwater extractions and recharge program in the Fox Canyon Groundwater Basin (including the conjunctively operated Fillmore and Piru Groundwater Basins) and its potential adverse effects on the amount and extent of surface flows and other water dependent habitat features utilized by the federally listed endangered southern California steelhead (*Oncorhynchus mykiss*).

The revised Draft GSP should be re-circulated to give NMFS, and other interested parties, an opportunity to review the revisions before the Draft GSP is finalized.

NMFS appreciates the opportunity to comment on the Draft GSP. If you have a question regarding this letter or enclosure, please contact Mr. Mark H. Capelli in our Santa Barbara Office (805) 963-6478 or mark.capelli@noaa.gov, or Mr. Andres Ticlavilca in our Santa Rosa Office (707) 575-6-54 or andres.ticlavilca@noaa.gov.

Sincerely,

Anthony P. Spina
Chief, Southern California Branch
California Coastal Office

cc:
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Steve Slack, CDFW, Region 5
Mary Ngo, CDFW, Region 5
Greg Martin, CDDR, Channel Coast District
Nate Cox, CDPR, Channel Coast District
Christopher Diel, USFWS, Ventura Field Office
Chris Dellith, USFWS, Ventura Field Office

Note: comments which share the major themes from the Appendix F introduction are not included in the comment matrix (Attachement 1) due to their volume and repetition and are addressed in a new appendix to the draft GSP (Appendix G). In order to distinguish the comments from CDFW, NGOs, and NMFS, which do not follow the major themes discussed below, they have been identified and labeled with numbers and boxes below and correspond with the numbers in the comment matrix table (see Attachment 1, comments #31-48).

NOAA's National Marine Fisheries Service's Comments on Preliminary Draft Mound Basin Groundwater Sustainability Plan (2021)

August 23, 2021

Overview

NOAA's National Marine Fisheries Service (NMFS) provides the following comments on the Draft Mound Basin Groundwater Sustainability Plan (Draft GSP), with a focus on Area 11 (*i.e.,* the lower Santa Clara River and Santa Clara River Estuary). Prior to presenting the comments, NMFS first provides background information on the endangered steelhead (*Oncorhynchus mykiss*), which reside in the Santa Clara River watershed, including the reach of the mainstem of the Santa Clara River and Santa Clara River Estuary underlain by the Mound Groundwater Basin. That background information includes the status of the species, life history and habitat requirements, and actions that are essential for recovery of the species. That information is essential for understanding the potential implications of operating the Mound Basin in the Santa Clara River for the endangered Southern California Distinct Population Segment (DPS) of steelhead. Our general and specific comments on the Draft GSP are presented in subsequent sections.

Status of Steelhead, Life History and Habitat Requirements, and Recovery Needs

Status of steelhead and habitat for the species in the Santa River Watershed

NMFS listed southern California steelhead, including the populations in the Santa Clara River watershed (which includes the Mound Groundwater Basin), as endangered in 1997 (62 FR 43937), and reaffirmed the endangered listing in 2006 (71 FR 5248).

NMFS designated critical habitat for southern California steelhead in 2005 (70 FR 52488). Within the Mound Basin, this designation includes the mainstem of the Santa Clara River and the Santa Clara River Estuary (*See* Figures 1 and 2).

Critical habitat for endangered steelhead includes: 1) freshwater spawning habitat with water quality and quantity conditions and substrate that support spawning, incubation, and larval development; 2) freshwater rearing sites with water quality and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility, and natural cover such as shade, submerged and overhanging vegetation that provide forage and refugia opportunities; and 3) freshwater migration corridors free of anthropogenic passage impediments that promote adult and juvenile mobility and survival.

Of particular relevance to the Draft GSP for the Mound Basin are the functions of the Santa Clara River Estuary. NMFS Southern California Steelhead Recovery Plan (2012) noted:

> "Each stream system terminates at the coast with some type of estuary-lagoon system. In southern California, seasonal lagoons currently tend to form each summer when decreased streamflows allow marine processes to build a sand berm at the mouth of each system. Juvenile steelhead over-summer in these lagoons, where they often grow so rapidly that they can undergo smoltification at age 1 and enter the ocean large enough to experience enhanced survival to adulthood (Hayes *et al*. 2008, Bond 2006)." P. 2-19.

NMFS Southern California Steelhead Recovery Plan further noted:

> "The timing of emigration is influenced by a variety of factors such as photoperiod, streamflow, temperature, and breaching of the sandbar at the river's mouth. These out-migrating juveniles, termed smolts [reference to Figure omitted]), live and grow to maturity in the ocean for two to four years before returning to freshwater to reproduce (citations omitted)." p. 2--2,

Steelhead populations in the SCS Recovery Planning area have not been extensively investigated; however, steelhead smolts have been documented in southern California estuaries, including the Santa Clara River Estuary *(e.g.,* Kelley 2008).

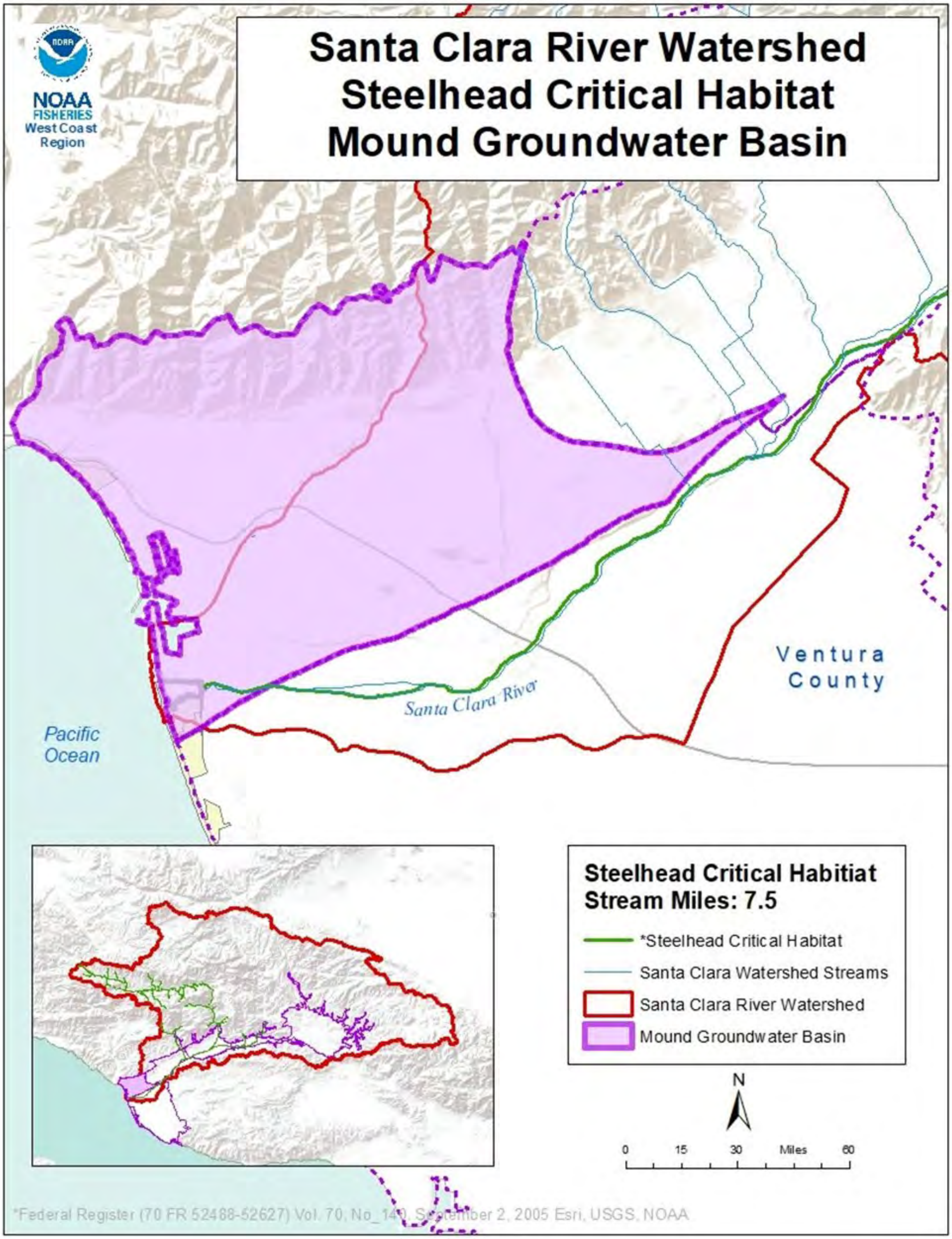

Figure 1. Lower Santa Clara River and Santa Clara River Estuary Steelhead Critical Habitat within the Mound Groundwater Basin.

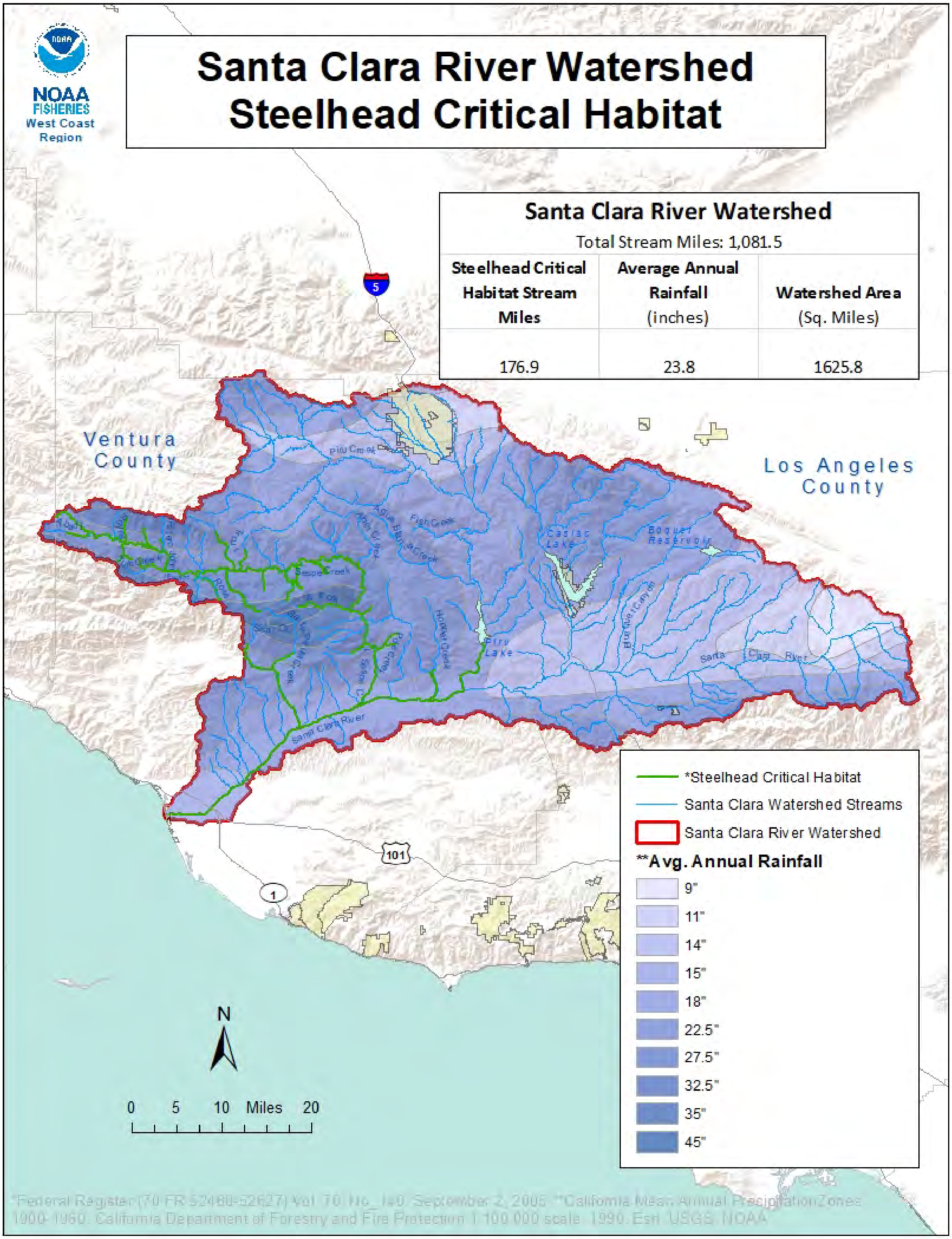

Figure 2. Santa Clara River Watershed Steelhead Critical Habitat.

Habitat for this species has been adversely affected by loss and modification of physical or biological features (substrate, water quality and quantity, water temperature channel morphology and complexity, passage conditions, riparian vegetation, introduction of non-native invasive species, etc.) through activities such as surface-water diversions and groundwater extractions (S*ee* "Current DPS-Level Threats Assessment", pp. 4-1 – 4-11, and "Threats and Threat Sources", pp. 9-14 – 9-17, in NMFS 2012). Additionally, estuaries in southern California have been reduced in size through filling and there habitat functions have been degraded through a variety of anthropogenic activities, such as water diversions and extractions and point and non-point waste discharges. The size of the pre-historic Santa Clara River Estuary is estimated to have been reduced by over half (U.S. Coast Survey 1855a, 1855b, Capelli 2007, Beller *et al*. 2011, Stein *et al.* 2014). Thus many of the physical and biological features of designated critical habitats have been significantly degraded (and in some cases lost) in ways detrimental to the biological needs of steelhead. These habitat modifications have hindered the ability of designated critical habitat to provide for the survival and ultimately recovery of this species.

NMFS has also modeled and mapped potential intrinsic potential spawning and rearing habitat in the Santa Clara watershed, using the "envelop method", as part of its recovery planning process for the endangered Southern California DPS of Steelhead (*See* Figure 3). This method uses observed associations between fish distribution and the quantitative values of environmental parameters such as stream gradient, summer mean discharge and air temperature, valley width to mean discharge, and the presence of alluvial deposits – habitat features that are critical to steelhead spawning and rearing (Boughton and Goslin 2006, Map 5, Santa Barbara to Point Dume, pp. 20-21).

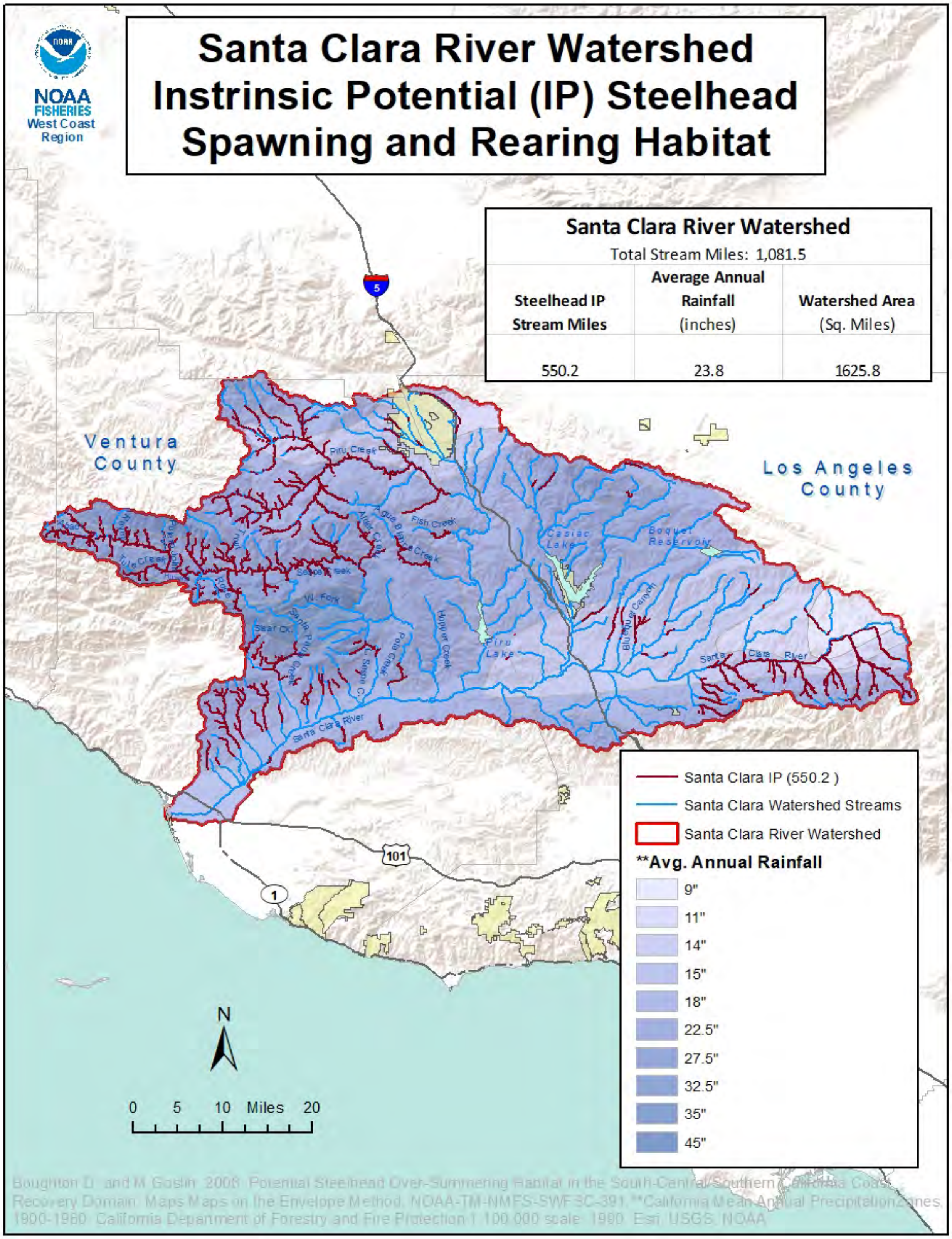

Figure 3. Santa Clara River Watershed Intrinsic Potential Steelhead Spawning and Rearing Habitat.

Steelhead life history and habitat requirements

Adult steelhead spend a majority of their adult life in the marine environment. However, the reproductive and early development stages of this species' life history occurs in the freshwater environment (migration to and from spawning areas, spawning, incubation of eggs and the rearing of juveniles), including in the main stem and tributaries such as those in the Santa Clara River watershed. Many of the natural variables (such as seasonal surface flow patterns, water quality, including water temperature) are significantly impacted by the artificial modification of these freshwater habitats. This includes both surface and sub-surface extractions that lower the water table and can, in turn, affect the timing, duration, and magnitude of surface flows essential for steelhead migration, spawning and rearing. In southern California, warm, dry summers require that juvenile steelhead have access to perennial stream reaches (including coastal estuaries) with tolerable water temperature (*See*, for example, Boughton *et al*. 2009). The over-summering period can be challenging to juvenile steelhead survival and growth. Surface diversions in combination with lowered groundwater tables during the dry season can *indirectly* affect rearing individuals by reducing vegetative cover, and *directly* by reducing or eliminating the summertime surface flows (or pool depths) in parts of the watershed. These conditions have been and are being exacerbated by global climate change (Beighley *et al*. 2008, Feng *et al*. 2019, Gudmundsson *et al*. 2021).

Recovery needs of endangered steelhead

Among other federally mandated responsibilities, NMFS is responsible for administering the U.S. Endangered Species Act for the protection and conservation of endangered steelhead utilizing the Santa Clara River Watershed. As part of this responsibility, NMFS developed the Southern California Steelhead Recovery Plan (NMFS 2012)[1]. Through a comprehensive analysis of systemic threats to this species, diversion of surface-flow and groundwater extractions were identified as "very high" threats to the long-term survival of endangered steelhead in the Santa Clara River (NMFS 2012, pp. 9-1 through 9-17).

To address the identified threats to endangered steelhead in the Santa Clara River Watershed, NMFS' Southern California Steelhead Recovery Plan identifies a number of recovery actions targeting surface diversions and groundwater extraction (NMFS 2012, p. 8-6, Table 9-7, p. 9-61). These include:

SCR-SCS-4.2 Develop and implement a water management plan to identify the appropriate diversion rates for all surface water diversions that will maintain surface flow necessary to support all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* migration, and suitable spawning, incubation, and rearing habitat.

[1] National Marine Fisheries Service. 2012. Southern California Coast Steelhead Recovery Plan. West Coast Region, California Coastal Area Office, Long Beach, California; *see* also, Keir Associates and National Marine Fisheries Service. 2008, Hunt & Associates Biological Consulting Services 2000.

SCR-SCS-6.1 Conduct groundwater extraction analysis and assessment. Conduct hydrological analysis to identify groundwater extraction rates, effects on the natural stream pattern (timing, duration and magnitude) of surface flows in the mainstem and tributaries, *and the estuary*, and effects on all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* migration, spawning, incubation, and rearing habitats. (emphasis added)

SAC-SCR-6.2 Develop and implement groundwater monitoring and management program. Develop and implement groundwater monitoring program to guide management of groundwater extractions to ensure surface flows provide essential support for all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* spawning, incubation and rearing habitats.

SAC-SCR-12.1 Develop and implement an estuary restoration and management plan.

GSPs developed under SGMA provide an important mechanism for implementing these recovery actions for the Santa Clara River watershed. The GSP for the Mound Basin is an essential mechanism for the implementation specific recovery actions for the lower Santa Clara River and the Santa Clara River Estuary.

General Comments on the Draft GSP

Impacting the natural process of groundwater inputs to surface flows and water surface elevations is of concern because the inputs can buffer daily water temperature fluctuations (Heath 1983, Brunke *et al.* 1996, Barlow and Leake 2012, Hebert 2016). Artificially reducing the groundwater inputs can expand or shrink the amount of fish habitat and feeding opportunities for rearing juvenile steelhead (Fetter 1997, Sophocleous 2002, Glasser *et al.* 2007, Croyle 2009,), and reduce opportunities for juveniles to successfully emigrate to the estuary and the ocean (Bond 2006, Hayes *et al.* 2008). Low summer baseflow, likely caused by both surface water diversions and pumping hydraulically connected groundwater, is noted as a significant stress to steelhead survival in the Santa Clara River and tributaries (*See*, for example, Table 9-2, p. 9-15 in NMFS 2012).

Management of the groundwater resources within the Santa Clara River watershed has affected the water resources and other related natural resources throughout the Santa Clara River watershed. For example, extraction of groundwater from these basins has lowered groundwater levels causing the elimination of artesian springs that formerly supported a wide variety of plant and animal species, and affected surface flows that support the migrations of endangered steelhead, as well as other aquatic species in the Santa Clara River watershed (Stillwater Sciences 2005. 2007a, 2007b, 2011a, 2011b, 2017).

The development and operation of surface water supply facilities throughout the Santa Clara River are integral in the management of the groundwater resources associated with the Santa Clara River. Facilities such as Pyramid Reservoir, Santa Felicia Dam, Piru Creek Diversion and spreading basins, and the Vern Freeman Diversion Dam and spreading basin have profoundly altered the natural surface flow and groundwater recharge patterns in the Santa Clara River watershed, from the headwaters to the Pacific Ocean (*e.g*., NMFS 2008a, 2008b, 2016, 2020, 2021). Unless the Draft GSP is revised to reflect the operation of these integral components of the groundwater management program for the Santa Clara River, the future adopted GSP will be unable to meet the requirement of SGMA to effectively provide for the protection of habitats, including those recognized instream beneficial uses that are dependent on groundwater such as fish migration, spawning and rearing, as well as other GDE within the Mound Basin.

When analyzing impacts on steelhead or other aquatic organisms resulting from groundwater and related streamflow diversions, identifying flow levels that effectively support essential life functions of this organism is critical (Barlow and Leake 2012). Specifically, it is essential to determine what flows adequately supports steelhead migration during the winter and spring, and juvenile rearing year round. Without an understanding of these hydrologic/biotic relationships, a GSP cannot ensure that significant and unreasonable adverse impacts from groundwater depletion (and in the case of the Santa Clara River, the integrally related surface water diversion/groundwater recharge program) are avoided (Heath 1983, California Department of Water Resources 2016).

Specific Comments on the Draft GSP

The following comments on the Executive Summary of the Draft GSP are arranged by page and paragraph number; additional comments on individual Draft GSP elements are presented subsequently.

31 **Executive Summary**

ES-1 Plan Area, Land Use, and Water Sources

Pages ES-ii-iii

The Draft Plan states:

> "The beneficial uses of groundwater extracted from the principal aquifers of Mound Basin include municipal, industrial, and agricultural water supply corresponding to the land use categories above." p. ES-ii

The listed beneficial uses within the boundaries of the Mound Groundwater Basin include only out-of-stream beneficial uses, and largely ignores the instream beneficial uses, including those linked to with GDE, including, but not limited to Area 11 (*i.e*., the lower Santa Clara River and Santa Clara River Estuary). The Draft GSP should be revised to explicitly acknowledge the instream beneficial uses supported by the groundwater basin, including the GDE associated with the lower Santa Clara River and Santa Clara River Estuary. The recognized instream beneficial uses for the portion of the lower Santa Clara

31 River within the Mound Basin include: warm freshwater habitat, cold freshwater habitat, wildlife habitat, habitat for rare, threatened and endangered species, fish migration, and wetland habitat. Santa Clara River Estuary instream beneficial uses include: estuarine habitat, marine habitat, wildlife habitat, habitat for rare, threatened and endangered species, fish migration, spawning habitat, and wetland habitat.[2]

32 **ES-2 Basin Setting and Groundwater Conditions**

Pages ES-iii-vi

The Draft GSP asserts that:

> "Despite the interconnection with shallow groundwater, there is no depletion of interconnected surface water in the Basin because there are no groundwater extractions from the shallow groundwater units and groundwater in the principal aquifers is physically separated from the surface water bodies by several hundred feet of fine-grained materials. No groundwater dependent ecosystems (GDEs) have been identified in the Basin that appear to be relying on groundwater from a principal aquifer."
> P. ES-vi

The regulations governing SGMA do not stipulate that the provisions of SGMA cover only "principal aquifers" as the Draft GSP appears to presume. The regulations define interconnected surface water as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water . . ." (23 CCR Section 351(0). Significantly, "continuous" refers specifically to hydrologic connection, not a continuous temporal connection.

The Draft GSP does not adequately recognize the potential role of groundwater in the lower reaches of the Santa Clara River or the Santa Clara River Estuary, or the role of groundwater elevations in ensuring surface flows water surface elevations and supporting the life-cycle of steelhead, including their migratory, spawning and rearing phases (*See* additional comments on Appendix A to the Draft Mound Basin GSP below.). Both the Santa Clara River estuary and the portion of the Santa Clara River upstream of Harbor Boulevard within the boundaries of the Oxnard Subbasin should be fully addressed in the revised Draft GSP. Further, because groundwater-management activities within the Santa Clara River watershed involve the United Water Conservation District's (UWCD) diversion operations at the Vern Freeman Diversion, the relationship between these diversion activities and groundwater elevations along the affected portion of the Santa Clara River (and estuary) should be addressed in the revised Draft GSP.

See additional comments below on interconnected groundwater and surface flows water surface elevations in Area 11 (*i.e.*, the lower Santa Clara River and Santa Clara River Estuary) of the Mound Basin.

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[2] Table 2. Beneficial Use of Inland Surface Waters, Los Angeles Regional Water Quality Control Board (2011). p. 2-7

33 **ES-3 Water Budget**

Pages ES-vi-vii

The Draft GSP notes that:

> "The primary sources of recharge to the Mound Basin groundwater system are underflow from the Santa Paula Basin, areal recharge (the sum of infiltration of precipitation, M&I return flows, and agricultural irrigation return flows), and mountain-front recharge. Stream channel recharge is a minor component." p. ES-vi

The revised Draft GSP should acknowledge that both the direct surface flow and the underflow from the Santa Paula Basin are influenced by the upstream diversion of surface flows in the Santa Clara River watershed and the artificial recharge of ground water as a result of the Vern Freeman Diversion located approximately 10 miles upstream of the Mound Basin.

34 **ES-4 Sustainable Management Criteria**

Pages ES-vii-x

The sustainable criteria are expressed explicitly and exclusively in terms of groundwater levels, water chemistry, and land subsidence, and do not explicitly recognize the important relationship between groundwater levels and the surface flows (particularly base flows) or water quality parameters (such as temperature, dissolved oxygen, *etc*.) that contribute to the maintenance of GDE within the Mound Basin (including, but not limited to, the lower Santa Clara River and the Santa Clara River Estuary).

There is no specific criterion in the Draft Criteria that deals with the GDE associated with the federally listed species (or the designated critical habitat) which utilize the Mount Basin[3]. In fact, the word "steelhead", "trout", or even "fish" do not appear in the Draft GSP. This is an important omission that should be corrected in the revised Draft GSP because GDE for the Mound Basin includes the use of surface flow by the federally listed endangered southern California steelhead for migration, spawning and rearing.

Specifically, the revised Draft GSP should include a description of the extent of designated critical habitat for endangered steelhead (as well as other listed or recognized sensitive species) that occur within the boundaries of the Mound Basin (*See* Figures 1 and 3).

ES-5 **Monitoring Networks**

Pages x-xii

[3] For a discussion of the terrestrial and as well as aquatic listed species, see, Stillwater (2007a) and California Department of Fish and Wildlife (2021).

The monitoring is primarily aimed at addressing the limited Sustainable Management Criteria. There is little in the monitoring program that specifically addresses the potential effects of groundwater extractions on GDE, including, but not limited to, the lower Santa Clara River channel and the Santa Clara River Estuary. *See* additional comments below regarding the inadequacies of the proposed monitoring program for the Mound Basin GSP.

Draft Mound Basin GSP

1.0 Introduction to Plan Contents [Article 5 §354]

The following comments are addressed to the specific sections and provisions of the draft GSP, arranged by the GSP section headings.

35

2.2.2.2 Existing Water Resource Management Programs [§354.8(c) and (d)]

Pages 9-11.

One of the largest and most significant water-resource-management program within the Santa Clara River watershed, the UWCD's groundwater recharge program, consisting of the combined facilities of the Santa Felicia Dam, Piru Diversion, Vern Freeman Diversion and a series of groundwater settling basins. This program and its related facilities should be included in this section because it affects not only the artificial recharge to the Fox Canyon aquifer, but the natural recharge to the other groundwater basins on the Oxnard Plain, including the Mound and Santa Paula Basins; *see* NMFS comments on the Fox Canyon GSP (2020)

36

2.2.2.3 Conjunctive Use Programs [§354.8(e)]

Page 11

The City of Ventura's water supply includes groundwater extractions (as well as surface diversions) that are subject to a separate GSP, and this fact should be noted in the revised Draft Mound GSP.

37

2.3 Notice and Communication [§354.10]

Page 22-24

The Draft GSP is focused out-of-stream users of the Mound Basin and does not adequately recognize the public trust natural resources that may be affected by the extractions of groundwater from the Mound Basin, and therefore be of interest to state and federal natural resource regulatory agencies such as NMFS, U.,S. Fish and Wildlife Service, and the California Department of Fish and Wildlife, and the California Department of Parks and Recreation (which owns a portion of the Santa Clara River Estuary wetlands).

2.3.1 Beneficial Uses and Users [§354.10(a)]

38 Pages 23-24

We would note that the listed beneficial uses within the boundaries of the Mound Basin identify only out-of-stream beneficial uses, and largely ignore instream beneficial uses. The revised Draft GSP should be revised to explicitly acknowledge the instream beneficial uses supported by the groundwater basin, including, but not limited to, the GDE associated with the lower Santa Clara River and Santa Clara River Estuary. *See* comment above.

3.0 Basin Setting [Article 5, SubArticle 2]

3.1.2 Regional Geology [§354.14(b)(1) and (d)(2)]

Pages 32-43

> "Some clay-rich soils within the Holocene and Pleistocene alluvial deposits present in Mound Basin may be of sufficiently low vertical permeability to allow the formation of thin, discontinuous lenses or layers of shallow, "perched" groundwater above the primary saturated zone of the shallow alluvial aquifer (described in the next subsection of this GSP)." p. 34

The variable permeability also characterizes the shallow upper alluvial aquifer that lays above the Mound Basin and allows connectivity between the upper alluvial aquifer and portion of the Mound Basin. See additional comments below regarding the physical properties of the Mound Basin and its multiple-layered aquifers.

3.1.4 Principal Aquifers and Aquitards [§354.14(b)(4)(A)]

> "The SGMA defines "principal aquifers" as "aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems." p. 35

While the shallow alluvial aquifer laying above the Mound Basin may be "rarely used for water supply", it does not follow that the provisions of the Draft GSP should only be limited to the Mound Basin. Because water in the overlying shallow alluvial aquifer can percolate to the aquifer below, reducing the groundwater level in the Mound Basin can result in lower groundwater levels in the shallow alluvial aquifer, thus affecting GDE associated with the shallow alluvial aquifer, including, but not limited to, surface water in the lower Santa Clara River, and the Santa Clara River Estuary. *See* additional comments below regarding the physical properties of the Mound Basin and the groundwater contribution the Santa Clara River Estuary.

39 **3.1.4.1 Physical Properties of Aquifers and Aquitards**

Pages 36-45

The Draft GSP notes:

39

> "At the time of writing of this GSP, no aquifer test results for hydraulic conductivity or storativity were found in available references. However, well information collected over the past several decades by United . . . is considered the best available information concerning aquifer and aquitard properties. . . However, it is recognized that on a local scale, hydraulic conductivity can vary by orders of magnitude over short distances, and there may be areas in Mound Basin where hydraulic conductivity is higher or lower than the values shown on Table 3.1-01." p. 39

The lack of specific information regarding hydraulic conductivity or storativity in the Mound Basin and the overlying shallow alluvial aquifer does not allow the categorical conclusions relied upon in the Draft GSP to eliminate consideration of GDE within the Mound Basin. The information and model used by United was focused on water conductivity and storativity that is more relevant to out-of-stream water supply and beneficial uses than the smaller values that may be relevant to support GDE.

We would also note that there are groundwater technologies that permits aquifer testing in individual layers of a multi-layered aquifers such as found in the Mound Basin. Pumping tests are essential for determining the hydrological conductivity and storativity of aquifer layers. Such tests must be at a fine enough scale to assess the significance for instream beneficial uses associated with GDE, including, but not limit to, those of the lower Santa Clara River and Santa Clara River Estuary, and not be limited to traditional out-of-stream beneficial uses such as domestic, municipal or agricultural water supply. Without these field-based measurements it is impossible to conduct credible aquifer simulations such as the one found in the Draft GSP dealing with groundwater levels driven by climate-change scenarios through 2070 (*See, e.g.*, Figure 4.6-03 of the Draft GSP.)

The Draft GSP further notes:

> "Since 1979, when reporting of groundwater extraction from wells was mandated within United's service area, no pumping has been reported from the shallow alluvial aquifer for water supply in Mound Basin (pumping data for water-supply wells are included in the Mound Basin Data Management System [DMS]), likely due to insufficient saturated thickness and/or poor water quality. Because it is not used for water supply, the shallow alluvial aquifer is not considered a "principal aquifer" at this time for the purpose of groundwater sustainability planning." p. 40

However, the Draft GSP also acknowledges that:

> "Based on calibration of its regional groundwater flow model, United (2021a) estimated the horizontal hydraulic conductivity of the shallow alluvial aquifer to be 200 ft/d in Mound Basin, and the vertical hydraulic conductivity to be 20 ft/d. The specific yield of the shallow alluvial aquifer in the groundwater flow model is 15% (United, 2021a). p. 40

The Mound Basin is a series of layered aquifers with variable hydraulic properties within and across layers. This is clearly depicted in the longitudinal cross-section A-A' in Figure 3.1-05 of the Draft GSP) (Figures, Section 2) depicting the formations constituting the various aquifer layers of the Mound Basin. The "aquitards" have fault discontinuities, and there is hydraulic connection between aquifers and aquitards". The hydraulic head that prevails in the layered aquifer system, including those in the "aquitards", are all interconnected. The lowering of the hydraulic head in deep aquifers will induce a vertical downward movement of groundwater from the shallow aquifer, which in turn is hydraulically connected to the Santa Clara River and the Santa Clara River Estuary.

As noted above, because water in the shallow alluvial aquifer can percolate to the lower Mount Basin aquifers, reducing the groundwater level in the Mound Basin can result in lower groundwater levels in the shallow alluvial aquifer, thus affecting GDE associated with the overlying shallow alluvial aquifer, including surface water in the lower Santa Clara River, and the Santa Clara River Estuary. Consequently, while the shallow alluvial aquifer may not be considered a "principal aquifer", pumping from the Mound Basin can affect the GDE associated with the shallow aquifer, including the lower reaches of the Santa Clara River and the Santa Clara River Estuary, and therefore cannot be omitted from the analysis of the Draft GSP for the Mound Basin. *See* additional comments below regarding groundwater contribution the Santa Clara River Estuary.

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3.1.4.2 Groundwater Recharge and Discharge Areas [§354.14(d)(4)]

Pages 44-45

The Draft GSP notes that:

> "The Santa Clara River is the only major stream in Mound Basin, and the reach of the Santa Clara River in [the] Mound Basin is considered to usually be the site of groundwater discharge, rather than recharge (Stillwater Sciences, 2011[b]; United, 2018). However, the lower Santa Clara River in the area of its estuary is reported to fluctuate from gaining to losing cycles as water levels rise and fall in response to breaching of the barrier sand at the mouth of the river (Stillwater Sciences, 2011[b[). When the elevation of surface water in the estuary rises (following closure of the barrier bar), some of the rising water infiltrates (recharges) the shallow deposits adjacent to the river. Then, typically in the following winter or spring, a large storm will produce sufficient flows in the river that it will breach the barrier bar and cause rapid decline of surface water levels in the estuary, causing groundwater in the adjacent shallow deposits to discharge back into the river over a sustained period." p. 45

This statement warrants several comments:

First, the distinction between discharge and recharge is misleading; the surface flows in the lower reaches of the Santa Clara River are in direct contact with the alluvial aquifer (which is described elsewhere in the draft GSP as being up to a 100 feet thick).

40 Second, river discharge (particularly base flows influence by underlying groundwater levels in the Mound Basin) support the GDE in this portion of the Mound Basin.

Third, recharge is not limited to periods when the water surface elevations in the estuary rises following the closure of the sand bar at the mouth of the Santa Clara River Estuary.

Lastly, the draft GSP does not accurately characterize the groundwater contribution to the Santa Clara River Estuary or the lower reaches of the Santa Clara River. According to a water balance assessment conducted by Stillwater Sciences (2011a, 2011b) for the fall/winter period of 2010, "groundwater was estimated to contribute approximately 15% of the inflow volume . . .". For the summer/spring 2010 period, "the groundwater contribution was estimated at 10 percent . . ." The Stillwater study also indicates that in the "Santa Clara River reach upstream of the estuary, groundwater provides the dry summer baseflow, if it exists, and is a quarter of the winter flow, based on the 2010 water year assessment." (TNC 2017, pp. 3-4).

3.1.4.3 Groundwater Quality [§354.14(b)(4)(D)]

Pages 45-50

The Draft GSP notes that:

> "SSP&A (2020) further concluded that there is no significant evidence for interactions between groundwater in the principal aquifers and shallow groundwater (CWP-510 is included here) or deeper, mineralized water. SSP&A (2020) also concluded that groundwater at the sample locations in the Basin is at least 1,000 years old. These conclusions together suggest that vertical movement of water percolating from land surface is not a major source of recharge to the principal aquifers, except where they are exposed at land surface in the northern portion of the basin." p. 46

The analysis and conclusion articulated here reflects a water supply for out-of-stream beneficial uses perspective that is pervasive throughout the Draft GSP. However, groundwater-surface interactions on smaller scale than would normally be considered in a traditional groundwater management program are relevant in considering the effects of groundwater management actions (including the timing, rate, and amount of groundwater extractions) on GDE such as the exist in the lower reaches of the Santa Clara River and the Santa Clara River Estuary.

3.1.4.4 Primary Beneficial Uses [§354.14(b)(4)(E)]

Pages 50-54

The Draft GSP recognizes that:

> "In addition to groundwater production from the principal aquifers, discharge of small quantities of groundwater from the shallow alluvial aquifer to the lower reach of the Santa Clara River and possibly one other

area in Mound Basin may contribute to groundwater-dependent ecosystems (GDEs). This potential beneficial groundwater use is further described in Section 3.2.6." p. 51

Despite the acknowledgement of groundwater-surface water interconnections, the Draft GSP concludes that because the shallow alluvial aquifer overlaying the Mound Basin is "rarely used for water supply", and the "likely limited, connection between Mound Basin shallow groundwater" there are not impacts to the GDEs by principal aquifer pumping, and therefore potential adverse Impacts will not be considered in the development of sustainable management criteria for the principal aquifers within the Mound Basin. For the reasons indicated above, this conclusion is not supported by the data presented in the Draft GSP. *See* additional Comments below regarding Appendix A, "Area 11- Lower Santa Clara River and Estuary."

The Draft GSP asserts:

"No data gaps or significant uncertainties were identified." p. 54

This claim is contradicted by the acknowledgement that "no aquifer test results for hydraulic conductivity or storativity were found in available references." p.39 *See* additional comments bellow on Monitoring Networks.

41

3.2 Groundwater Conditions [§354.16]

Pages 54-69

The Draft GSP notes that:

> "Groundwater elevation data are available for nearly 60 wells located within Mound Basin. However, not all of these wells are being monitored at present. The distribution of wells is heavily skewed towards the southern half of the Basin, with relatively few wells existing in the northern half of the Basin (north of Highway 126)." p. 54

The Draft GSP does not provide details regarding the well construction showing the intervals of the well through which groundwater enters the wells. Also, it is unclear if there are "sanitary plugs" installed in the wells that retard or prevent flow through shallow and deep aquifers. *See* comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

42

3.2.1 Groundwater Elevations [§354.16(a)]

Page 54

The Draft GSP acknowledges that:

> "The contouring of groundwater levels in Mound Basin is complicated by the sparse data, particularly in the northern portion of the Basin." p. 54

42 *See* comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

43 **3.2.2 Change in Storage [§354.16(b)]**

> "Similar to contouring of groundwater levels in Mound Basin (as described above), estimation of historical changes in groundwater stored in the Basin is complicated by sparse groundwater elevation data, particularly in the northern portion of the Basin and in HSUs with few monitoring points. Due to these limitations, annual and cumulative changes in groundwater in storage were estimated using United's (2018 and 2021a, 2021b) groundwater flow model, which is generally well calibrated on a regional scale to groundwater elevation measurements." p. 60

Groundwater models that are aimed at a "regional scale" are not likely to adequately describe changes in groundwater and surface water elevations (particularly base flows) that support localized GDE such as those associated with the lower Santa Clara River and the Santa Clara River Estuary, as well as other GDE within the Mound Basin identified by the California Department of Fish and Wildlife (2021). *See* comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

3.2.3 Seawater Intrusion [§354.16(c)]

Pages 61-62

The Draft GSP notes that:

> "Due to the lack of evidence of seawater intrusion in onshore portions of the Basin and lack of data concerning the location of any offshore seawater intrusion front in the principal aquifers, the maps and cross-sections of the seawater intrusion front required pursuant to §354.16(c) cannot be prepared." p. 62

See comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

3.2.6 Interconnected Surface Water Systems [§354.16(f)]

Pages 67-68

The Draft GSP notes that:

> "Data are not available to characterize the interconnection of Santa Clara River surface water and groundwater. Although the frequent perennial baseflow conditions imply that surface and groundwater is interconnected, it is not known specifically which groundwater in which units are

> connected and where. Of importance for this GSP, it is unknown whether the water table of the shallow alluvial aquifer in Mound Basin extends beneath the stream terrace deposits and intersects surface water in the Santa Clara River channel within the limits of Mound Basin." p. 67

However, the Draft GSP concludes that:

> "Regardless of the questions and uncertainty surrounding interconnection of shallow aquifer and/or stream terrace groundwater with the Santa Clara River baseflow, it can be concluded that there is no depletion of interconnected surface water in this area because neither unit has any known groundwater extractions within Mound Basin." p. 68.

As noted above, while the shallow alluvial aquifer laying about the Mound Basin may be "rarely used for water supply", it does not follow that there is "no depletion of interconnected surface water within the boundaries of the Mound Basin." Because water in the shallow alluvial aquifer can percolate to the aquifer below, reducing the groundwater level in the Mound Basin can result in lower groundwater levels in the shallow alluvial aquifer, thus affecting GDE associated with the shallow alluvial aquifer, including surface water in the lower Santa Clara River, and the Santa Clara River Estuary. *See* additional comments above regarding the physical properties of the Mound Basin, as well as those below regarding groundwater contribution the Santa Clara River Estuary.

3.2.7 Groundwater-Dependent Ecosystems [§354.16(g)]

Pages 68-69

The Draft GSP states that:

> " . . .it is noted that there is no known shallow groundwater extraction within Mound Basin. . . . Given the lack of potential for significant impacts to the GDEs by principal aquifer pumping, Area 11 [*i.e.*, lower Santa Clara River and Santa Clara River Estuary] will not be considered further in the development of sustainable management criteria for the principal aquifers." p. 69

As noted above the data presented in the Draft GSP does not support this assessment and conclusion. *See* additional comment above regarding the physical properties of the Mound Basin and those below regarding Appendix A, "Area 11- Lower Santa Clara River and Estuary."

3.3 Water Budget [§354.18]

Pages 70-97

See comments below regarding individual sub-sections of the Water Budget.

44

3.3.1 Historical Water Budget [§354.18(c)(2)(B)]

Pages 79-82

The Draft GSP notes that:

"The SGMA Regulations require that the historical surface water and groundwater budget be based on a minimum of 10 years of historical data." p. 79

The GSP does not refer to or account for the effects of the operation of the UWCD Vern Freeman Diversion on the lower Santa Clara River, which diverts, on average, over 62,000 acre-feet per year (AFY) from the main stem of the Santa Clara River (NMFS 2018). This diversion operation affects recharge to all of the lower Santa Clara River groundwater basins, not just the Fox Canyon Basin, including the shallow alluvial aquifer and the other deeper aquifers in within the Mound Basin. These operations have the potential to impact endangered adult and juvenile steelhead in the lower Santa Clara River and Santa Clara River Estuary (NMFS 2008a, 2018). The Draft GSP should therefore include as part of its water-budget analysis the operations of the Vern Freeman Diversion. Specifically, the relationship of groundwater management activities (including both recharge and groundwater extraction activities) and the effects of the related Vern Freeman Diversion on surface flows below the diversion and the maintenance of surface flows supported by groundwater should be explicitly addressed and disclosed in the revised GSP.

3.3.1.3 Impact of Historical Conditions on Basin Operations [§354.18(c)(2)(C)]

Pages 83-84

See comments above regarding Historical Water Budget.

3.3.2 Current Water Budget [§354.18(c)(1)]

Pages 84-86

As noted above, the GSP does not refer to or account for the effects of the operation of the UWCD Vern Freeman Diversion on the Lower Santa Clara River, but should as part of its current water budget. See comments above regarding the UWCD Vern Freeman Diversion.

3.3.3 Projected Water Budget

Pages 86-94

As noted above, the GSP does not refer to or account for the effects of the operation of the Vern Freeman Diversion on the Lower Santa Clara River, but should as part of its projected water budget. See comments above regarding the UWCD Vern Freeman Diversion.

45 **3.3.4.1 Overdraft Assessment**

Pages 95-96

The Draft GSP notes that:

> "Review of the historical, current and projected groundwater budgets indicate small amounts of declining groundwater storage over time (469 and 147 for the historical and current periods, respectively), as shown in Table 3.3-03. These results suggest a minor amount of overdraft may have occurred during the historical and current period of 6.3% and 2.3%, respectively, of the groundwater pumping during that timeframe." p. 96

While the Draft GSP does not identify any significant impacts to out-of-stream water supply beneficial uses of the Mound Basin (and in fact projects a slight increase of 68 to 84 AF/yr) between 2022 and 2096, under the assumed future-precipitation rates modeled), the implications from this slight overdraft or increase in storage for any of the GDE associated with the Mount Basin, including the lower Santa Clara River and Santa Clara River Estuary, are unclear

3.4 Management Areas [§354.20]

Page 97

The Draft GSP indicates that:

"No management areas were established for this GSP". p. 97.

This decision appears to be the result, in part, of not recognizing any significant interconnected surface water or GDE within the boundaries of the Mound Basin. However, as noted above, the Mound Basin contains interconnected water and GDE. Additionally, the analysis in the Draft GSP is largely from a water supply perspective, with an emphasis on out-of-stream beneficial uses, and does not recognized water conductivity and storativity that is more relevant to instream beneficial uses associated with GDE, including but not limited to those in Area 11 (*i.e.*, the lower Santa Clara River and Santa Clara River Estuary) .*See* comments above regarding the physical properties of the Mound Basin.

4.0 Sustainable Management Criteria [Article 5, SubArticle 3]

Pages 98-148 *See* comments below on individual sub-sections.

4.2 Sustainability Goal [§354.24]

Pages 90-100

The Draft GSP states, in part, that:

46 “The goal of this Groundwater Sustainability Plan (GSP) is to sustainably manage the groundwater resources of the Mound Basin for the benefit of current and anticipated future beneficial users of groundwater and the welfare of the general public who rely directly or indirectly on groundwater. Sustainable groundwater management will ensure the long-term reliability of the Mound Basin groundwater resources by avoiding undesirable results pursuant to the Sustainable Groundwater Management Act (SGMA) no later than 20 years from GSP adoption through implementation of a data-driven and performance-based adaptive management framework.” P. 100

Nothing in the language of the goals specifically refers to the protection of instream beneficial uses associated with GDE of the Mount Basin, such as the lower Santa Clara River or the Santa Clara River Estuary. This appears to be the result, in part, of not recognizing any interconnected surface waters or GDE within the boundaries of the Mound Basin. However, as noted above, the Mound Basin contains interconnected surface water and GDE. *See* comments above regarding the physical properties of the Mound Basin.

4.3 Process for Establishing Sustainable Management Criteria [§354.26(a), §354.34(g)(3)]

Pages 101-102

See comments above regarding the interest of state and federal natural resource regulatory agencies such as NMFS, U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife, and the California Department of Parks and Recreation (which owns a portion of the Santa Clara River Estuary wetlands).

Evaluation of Potential Effects on Beneficial Uses and Users, Land Uses, and Property Interests [§354.26(b)(3)]

Pages 103-104

The discussion in this section is focused on out-of-stream beneficial uses of the groundwater resources of the Mount Basin, and does not directly address the instream beneficial uses of interest to state and federal natural resource regulatory agencies such as NMFS, U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife, and the California Department of Parks and Recreation. These would include, but are not limited to, the GDE associated with the lower Santa Clara River and the Santa Clara River Estuary.

Cause of Groundwater Conditions That Could Lead to Undesirable Results [§354.26(b)(1)]

Pages 104-105

The causes that could lead to undesirable results should include the operations of UWCD Vern Freeman Diversion on the lower Santa Clara River. *See* comments above, particularly regarding GDE.

4.4.2 Minimum Thresholds [§354.28]

Pages 105-107

None of the minimum thresholds in the Draft GSP deal specifically with the GDE associated with the Mound Basin, which include the lower Santa Clara River and the Santa Clara River Estuary. This is a significant omission from the Draft GSP that should be addressed in the revised Draft GSP for the Mound Basin.

4.4.2.2 Relationships Between Minimum Thresholds and Sustainability Indicators [§354.28(b)(2)]

Page 108

See general comment above regarding "Minimum Thresholds" and those below regarding "Criteria Used to Define Undesirable Results".

4.4.2.3 Minimum Thresholds in Relation to Adjacent Basins [§354.28(b)(3)]

Page 108

See general comment above regarding Minimum Thresholds and the operation of the UWCD Vern Freeman Diversion.

4.4.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

Page 108

See general comment above regarding "Minimum Thresholds" and those below regarding Criteria Used to Define Undesirable Results" below.

Groundwater Beneficial Users (All Types)

Page 109

Land Uses and Property Interests (All Types)

Page 109

See comments above regarding the interest of state and federal natural resource regulatory agencies such as NMFS, U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife, and the California Department of Parks and Recreation (which owns a portion of the Santa Clara River Estuary wetlands).

4.4.2.5 Potential Effects on other Sustainability Indicators [§354.28(c)(1)(B)]

Pages 109-110

See general comment above regarding “Minimum Thresholds” and those below regarding Criteria Used to Define Undesirable Results”.

Depletion of Interconnected Surface Water

Page 110

The Draft GSP states that:

> “This sustainability indicator is not applicable to the Mound Basin.” (p. 110)

As noted above, while the shallow alluvial aquifer laying about the Mound Basin may be “rarely used for water supply”, it does not follow that there is “no depletion of interconnected surface water within the boundaries of the Mound Basin.” Because water in the shallow alluvial aquifer can percolate to the aquifer below, reducing the groundwater level in the Mound Basin can result in lower groundwater levels in the shallow alluvial aquifer, thus affecting GDE associated with the shallow alluvial aquifer, including surface water in the lower Santa Clara River, and the Santa Clara River Estuary. *See* additional comments above the physical properties of the Mound Basin and the groundwater contribution the Santa Clara River Estuary.

4.4.2.6 Current Standards Relevant to Sustainability Indicator [§354.28(b)(5)]

Page 111

> “MBGSA [Mound Basin Groundwater Sustainability Agency] is unaware of any federal, state, or local standards for chronic lowering of groundwater levels.” p. 110

While there is no general numeric standards for chronic lowering of groundwater levels, this statement fails to recognize the over-arching standards established by SGMA, particularly those intended to protect GDE.

4.4.2.7 Measurement of Minimum Thresholds [§354.28(b)(6)]

Page 111

> “Groundwater elevations will be directly measured to determine their relation to minimum thresholds. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in Section 5.” p. 111

The groundwater-monitoring plan only provides for annual monitoring. A more appropriate approach would be to monitor seasonally to account for the strong effect of seasonal changes in hydrologic and hydraulic conditions that are of significant to GDE, including, but not limited to, those associated with the lower Santa Clara River and the Santa Clara River Estuary. For example, monitoring towards the end of summer or beginning of fall, as well as the beginning of Spring each year could help inform groundwater and other natural resource managers of the effects of both recharge (natural and artificial) as well as groundwater pumping patterns on GDE within the Mound Basin such as the lower Santa Clara River and Santa Clara River Estuary.

Without shallow groundwater wells that would provide specific data on the relationship between groundwater levels and surface flows, a reliable assessment of the effects of extracting groundwater from these areas on GDE is not possible. This is a significant data gap that could be addressed by the installation of shallow groundwater wells (or piezometers) to better describe these relationships.

Additionally, data gathered from groundwater well monitoring should be correlated with stream flow in the lower Santa Clara River and surface water elevations in the Santa Clara River Estuary. This can and should be accomplished by added a stream flow gauges capable of monitoring base flows in the lower Santa Clara River between U.S. Highway 101 and the Harbor Boulevard Bridge, as well as one or more water surface elevation gauges within the Santa Clara River Estuary.

See general comment above regarding “Minimum Thresholds” and those below regarding “Criteria Used to Define Undesirable Results”.

4.4.3 Measurable Objectives and Interim Milestones [§354.30(a),(b),(c),(d),(e),(g)]

Page 111

See general comment above regarding “Minimum Thresholds” and those below regarding “Criteria Used to Define Undesirable Results”.

47 **4.4.3.1 Description of Measurable Objectives**
Western Half of Basin

Page 112

The Draft GSP notes that:

> “The chronic lowering of groundwater levels minimum thresholds in the western half of the Basin are superseded by the land subsidence proxy minimum thresholds. Therefore, the land subsidence proxy measurable objectives and interim milestones are adopted for the chronic lowering of groundwater levels measurable objectives in the western half of the Basin.” p. 112

It is not clear how, or if, the land subsidence proxy for minimum thresholds is appropriate for instream beneficial uses associated by GDE supported by interconnected waters. *See* also, general comment above regarding Minimum Thresholds.

Eastern Half of the Basin

4.4.3.2 Interim Milestones [§354.30(e)]

Page 113

See general comment above regarding "Minimum Thresholds" and those below regarding "Criteria Used to Define Undesirable Results".

Western Half of Basin

Page 113

See general comment above regarding "Minimum Thresholds" and those below regarding "Criteria Used to Define Undesirable Results".

Eastern Half of Basin

Page 113

See general comment above regarding "Minimum Thresholds" and those below regarding "Criteria Used to Define Undesirable Results".

4.5 Reduction of Groundwater Storage

4.5.1 Undesirable Results [§354.26]

Pages 114-116

See general comment above regarding Minimum Thresholds.

Evaluation of Potential Effects on Beneficial Uses and Users, Land Uses, and Property Interests [§354.26(b)(3)]

The Draft GSP states that:

> "The evaluation of potential effects on beneficial uses and users, land uses, and property interests for the reduction of groundwater storage sustainability indicator is the same as for the other sustainability indicators and is incorporated herein by reference to Sections 4.4.2.4, 4.6.2.4, and 4.7.2.4.

And,

> "Reduction of groundwater storage has the potential to impact the beneficial uses and users of groundwater in the Mound Basin by limiting the volume of groundwater available that can be economically extracted for agricultural, municipal, industrial, and domestic use. These impacts

> can affect all users of groundwater in the Mound Basin. Groundwater elevations are used to determine whether significant and unreasonable reduction of groundwater in storage is occurring." p. 115

As noted previously, the Draft GSP should be revised to explicitly acknowledge the instream beneficial uses supported by the Mound Basin and its individual aquifers, including, but not limited to, the GDE associated with the lower Santa Clara River and Santa Clara River Estuary. The recognized instream beneficial uses for the portion of the lower Santa Clara River within the Mound Basin include: warm freshwater habitat, cold freshwater habitat, wildlife habitat, habitat for rare, threatened and endangered species, fish migration, and wetland habitat. Santa Clara River Estuary instream beneficial uses include: estuarine habitat, marine habitat, wildlife habitat, habitat for rare, threatened and endangered species, fish migration, spawning habitat, and wetland habitat.

Criteria Used to Define Undesirable Results [§354.26(b)(2)]

The Draft GSP states that:

> "The criteria used to define undesirable results for the reduction of groundwater storage sustainability indicator are based on the qualitative description of undesirable results, which is causing other sustainability indicators to have undesirable results. As explained in Section 4.5.2, groundwater levels will be used as a proxy for the reduction of groundwater storage sustainability indicator minimum thresholds. Based on the foregoing, the combination of minimum threshold exceedances that is deemed to cause significant and unreasonable effects in the basin for the reduction of groundwater storage sustainability indicator is the same as the combinations deemed to cause undesirable results for the land subsidence sustainability indicator (western half of the Basin) and chronic lowering of groundwater levels sustainability indicator (eastern half of the Basin) (Table 4.1-01)." p. 116

While groundwater levels are important indicator of the general condition of the groundwater basin, such metrics are not a substitute for metrics that are specifically aimed at informing management of the Mound Basin for the purpose of protecting instream beneficial associated with GDE within Mound Basin, including the lower Santa Clara River and the Santa Clara River Estuary. Specifically, these criteria do not address whether there may be significant stream flow depletion or lowered water surface elevation (from a biological perspective) caused by groundwater pumping within the Mound Basin. *See* general comment above regarding "Minimum Thresholds" regarding GDE.

48 **4.5.2.2 Relationships Between Minimum Thresholds and Sustainability Indicators [§354.28(b)(2)]**

> "The minimum thresholds for the reduction of groundwater storage sustainability indicator allow groundwater levels to decline below

48

> historical low levels in the eastern half of the Basin. Deeper groundwater levels could potentially increase underflow into the Mound Basin from the Oxnard and/or Santa Paula Basins (or decrease underflow to the Oxnard Basin), which could potentially contribute to undesirable results in those Basins. However, as noted above and in Section 4.4.2.1, the length of time that groundwater levels could remain below historical lows would be limited in order to prevent undesirable results for land subsidence in the western half of the Mound Basin; therefore, the potential effect on the adjacent basins is considered small." p. 118

This approach and analysis may be appropriate when considering groundwater supplies for out-of-stream beneficial uses for which there may be alternatives. However, it does not take into account the adverse effects of periodic reduction of groundwater on GDE, including the use by migrating, spawning or rearing steelhead. The effects of periodic groundwater reductions on out-of-stream beneficial uses (*e.g.*, domestic or agricultural water supplies) may be addressed with alternative water sources. However, instream uses such as GDE are more vulnerable to periodic groundwater reductions, because there is generally no alternative water source to sustain the GDE, and even a short-term depletion or limitation of stream flow or water surface elevation can be lethal to aquatic species.

4.5.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

Page 119

> "The effects on beneficial users and land uses in the Basin are the same as analyzed for the land subsidence sustainability indicator (western half of Basin) and chronic lowering of groundwater levels sustainability indicator (eastern half of Basin) and are incorporated herein by reference to Sections 4.4.2.4 and 4.8.2.4." p. 119

See the comments above regarding "Criteria Used to Define Undesirable Results" and Relationship Between Minimum Thresholds and Sustainability Indicators".

4.5.2.5 Current Standards Relevant to Sustainability Indicator [§354.28(b)(5)]

Page 119

"MBGSA is unaware of any federal, state, or local standards for reduction of groundwater storage." p. 119

As noted above, while there are no numeric standards, this statement does not appear to recognize the standards that that are established by SGMA, particularly regarding GDE.

4.5.2.6 Measurement of Minimum Thresholds [§354.28(b)(6)]

Page 119

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.5.3 Measurable Objectives and Interim Milestones [§354.30(a),(b),(c),(d),(e),(g)]

Page 120

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.5.3.1 Description of Measurable Objectives

Page 120

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

Western Half of Basin

See general comment above regarding "Minimum Thresholds" regarding GDE.

Eastern Half of Basin

See general comment above regarding "Minimum Thresholds" regarding GDE.

4.6 Seawater Intrusion

Pages 120-121

See comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

4.6.1 Undesirable Results [§354.26]

Pages 122-124

See comment above regarding the assertion that "No data gaps or significant uncertainties were identified."

Process and Criteria for Defining Undesirable Results [§354.26(a)]

Page 122

See comments above regarding the interest of state and federal natural resource regulatory agencies such as NMFS, U.S. Fish and Wildlife Service, and the California

Department of Fish and Wildlife, and the California Department of Parks and Recreation (which owns a portion of the Santa Clara River Estuary wetlands).

Evaluation of Potential Effects on Beneficial Uses and Users, Land Uses, and Property Interests [§354.26(b)(3)]

Page 122

As noted previously, the Draft GSP should be revised to explicitly acknowledge the instream beneficial uses supported by the groundwater basin, including the GDE associated with the lower Santa Clara River and Santa Clara River Estuary. *See* comment above regarding “Process and Criteria for Defining Undesirable Results”.

Criteria Used to Define Undesirable Results [§354.26(b)(2)]

Pages 123-124

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.6.2 Minimum Thresholds [§354.28]

4.6.2.1 Information and Criteria to Define Minimum Thresholds [§354.28(a), (b)(1),(c)(3)(A),(c)(3)(B), and (e)]

Page 124-125

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.6.2.2 Relationships Between Minimum Thresholds and Sustainability Indicators [§354.28(b)(2)]

Pages 125-126

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.6.2.3 Minimum Thresholds in Relation to Adjacent Basins [§354.28(b)(3)]

Page 126

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results”, “Relationship Between Minimum Thresholds and Sustainability Indicators”, the UWCD Vern Freeman Diversion.

4.6.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

Pages 126-127

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.6.2.5 Current Standards Relevant to Sustainability Indicator [§354.28(b)(5)]

Page 127

> "MBGSA is unaware of any federal, state, or local standards for seawater intrusion other than the WQOs included in the RWQCB-LA Basin Plan (RWQCB-LA, 2019). The minimum threshold for seawater intrusion is equal to the RWQCB Basin Plan WQO for chloride." p. 127

This statement does not appear to recognize the broad standards that that are established by SGMA.

4.6.2.6 Measurement of Minimum Thresholds [§354.28(b)(6)]

Page 127

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.6.3 Measurable Objectives and Interim Milestones [§354.30(a),(b),(c),(d),(e),(g)]

Page 128

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.7 Degraded Water Quality

Pages 128-136

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.7.1 Undesirable Results [§354.26]

Page 130

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

Process and Criteria for Defining Undesirable Results [§354.26(a)]

Page 130

See comments above regarding the interest of state and federal natural resource regulatory agencies such as NMFS, U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife, and the California Department of Parks and Recreation (which owns a portion of the Santa Clara River Estuary wetlands).

Evaluation of Potential Effects on Beneficial Uses and Users, Land Uses, and Property Interests [§354.26(b)(3)]

Page 130

As noted previously, the Draft GSP should be revised to explicitly acknowledge the instream beneficial uses supported by the groundwater basin, including the GDE associated with the lower Santa Clara River and Santa Clara River Estuary. *See* comment above regarding "Process and Criteria for Defining Undesirable Results."

Cause of Groundwater Conditions That Could Lead to Undesirable Results [§354.26(b)(

Page 131

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

Criteria Used to Define Undesirable Results [§354.26(b)(2)]

Page 131

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.7.2 Minimum Thresholds [§354.28]

Page 131

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

4.7.2.2 Relationships Between Minimum Thresholds and Sustainability Indicators [§354.28(b)(2)]

Page 133

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.7.2.3 Minimum Thresholds in Relation to Adjacent Basins [§354.28(b)(3)]

Page 134

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.7.2.5 Current Standards Relevant to Sustainability Indicator [§354.28(b)(5)]

Page 135

As noted above, while there is are no numeric standard, this statement does not appear to recognize the standards that that are established by SGMA, particularly regarding GDE.

4.7.3 Measurable Objectives and Interim Milestones [§354.30(a),(b),(c),(d),(e),(g)]

Page 136

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.7.3.1 Interim Milestones [§354.30(e)]

Page 136

See the comments above regarding “Minimum Thresholds”, “Criteria Used to Define Undesirable Results” and “Relationship Between Minimum Thresholds and Sustainability Indicators.”

4.8 Land Subsidence

Page 137-148

As noted above, it is not clear how, or if, the land subsidence proxy for minimum thresholds is appropriate for within-stream beneficial uses associated by GDE supported by interconnected waters. *See* also, general comment above regarding Minimum Thresholds.

4.9 Depletions of Interconnected Surface Water

Page 148

The Draft GSP asserts that:

> "Depletions of interconnected surface water is not an applicable indicator of groundwater sustainability in the Mound Basin and, therefore, no SMC [Sustainable Management Criteria] are set. Section 3.2.6 Interconnected Surface Water Systems provides the evidence for the inapplicability of this sustainability indicator.| p. 148

As noted in the comments above, this statement and the conclusion associated with it are not supported by either the evidence or the analysis presented in the Draft GSP. Rather, the Draft GSP either ignores or mis-interprets the physical properties of the Mound Basin, and applies an inappropriate standard for the evaluation of potential effects of groundwater extraction from the Mound Basin on GDE within the Mound Basin, including, but not limited to the Area 11 (i.e., the lower Santa Clara River and Santa Clara River Estuary). Further, the Draft GSP fails to acknowledge or take into account the effects of the operation of the UWCD Vern Freeman Diversion on the lower Santa Clara River, which diverts, on average, over 62,000 acre-feet per year (AFY) from the main stem of the Santa Clara River (NMFS 2018). This diversion operation affects recharge to all of the lower Santa Clara River groundwater basins, not just the Fox Canyon Basin, including the shallow alluvial aquifer and the other deeper aquifers in within the Mound Basin.

4.10 Measurable Objectives and Interim Milestones for Additional Plan Elements [§354.30(f)]

Page 148

> "No measurable objectives were developed for the additional plan elements included in the GSP." p. 148

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators"

5.0 Monitoring Networks [Article 5, SubArticle 4]

Pages 149-177

The Draft GSP notes:

> "Surface flows in the Santa Clara River are measured daily by the VCWPD [Ventura County Watershed Protection District] at flow-gaging station '723 - Santa Clara River at Victoria Ave' located outside of the Basin. Data from this station are available online and can be downloaded

> annually to update this surface water component of the Mound Basin water budget (VCWPD, 2021). MBGSA intends to continue using data from these existing sources as input to United's model, which will in turn be used periodically to quantify changes in water-budget components. At present, this GSP does not contemplate development of a new monitoring network or modification of existing monitoring networks to obtain data regarding groundwater pumping, imported water, or recharge quantities because it is MBGSA's opinion that these water budget components are currently adequate for sustainable management of the Basin." p. 53

However, the Draft GSP earlier (p. 67) acknowledges that gauge 723 is poorly calibrated to measure low flows in the Santa Clara River. These lower flows, while of less importance from traditional water supply perspective, do provide important support for GDE such as those associated with the lower Santa Clara River and the Santa Clara River Estuary within the Mound Basin.

As noted above, the monitoring proposed is aimed at addressing the limited Sustainable Management Criteria. There is nothing identified in the monitoring program that addresses the potential effects of groundwater extractions on GDE, including the lower Santa Clara River channel and the Santa Clara River Estuary. Shallow groundwater wells within the alluvial overlaying the Mound Basin would provide specific data on relationship between groundwater levels and surface flows. This appears to be a significant data gap that should be addressed by the installation of shallow groundwater wells (or piezometers) to better described these relationships.

6.0 Projects and Management Actions [Article 5, SubArticle 5]

Pages 178-191

The Draft GSP indicates that"

> "No management areas were established for this GSP".

This decision appears to be the result, in part, on not recognizing any interconnected surface water or GDE within the boundaries of the Mound Basin. However, as noted above, the Mound Basin does contain interconnected water and GDE.

In addition to monitoring the effects of groundwater (and related surface water diversions) within the Mound Basin, the Draft GSP should recognized other management activities that affect both water supply for out-of-stream beneficial uses and GDE, including, but not limited to, the lower Santa Clara River and the Santa Clara River Estuary.

The introduction and spread of the non-native, invasive giant reed *Arundo donax* has degraded both terrestrial and aquatic habitats within the Mound Basin, including GDE associated with lower Santa Clara River and Santa Clara River Estuary. In addition to displacing native riparian habitat important to a number of terrestrial and aquatic species, including steelhead, *Arundo donax* draws heavily on groundwater, and can reduce stream flow (particularly bae flows) due to the interconnected nature of surface flows within the Mound Basin (The Nature Conservancy 2019, Stover *et al.* 2018, Dudley and Cole 2018). As part of its over-all groundwater management project, therefore, the MGBSA should include an aggressive Arundo donax removal program, coordinated with adjacent landowners, including the California Department of Parks and Recreation and the Ventura County Watershed Protection District.

See the comments above regarding "Minimum Thresholds", "Criteria Used to Define Undesirable Results" and "Relationship Between Minimum Thresholds and Sustainability Indicators."

7.0 GSP Implementation

Pages 192-198

See comment above regarding "Projects and Management Actions".

Appendix A to Draft Mound Basin GSP

Area 11 – Lower Santa Clara River and Estuary

Pages 7-8

The description of the lower reaches of the Santa Clara River and Santa Clara River Estuary is based almost entirely on Grossinger, *et al* (2011), which was largely limited to a description of the vegetative characteristics of the wetlands of the Southern California Coast. That study, while providing valuable information on the type and distribution of various vegetative communities, does not provide comparable information on aquatic species associated with the Santa Clara River or its Estuary. The habitats covered here are principally riparian and terrestrial, omitting coverage of various types of aquatic habitats. Also, the characterization did not reference the more focused historical investigation prepared by Beller *et al*. (2011), which provided additional information on the wetland resources of the lower Santa Clara River and Santa Clara River Estuary, though it also did not provide significant information on fish, wildlife, and other species associated with the GDEs within the Mount Basin.

As a result, the characterization of the habitats and species associated with the lower Santa Clara River and Santa Clara River Estuary is incomplete and misleading. For example, while the pre-historic size and complexity of the Santa Clara River Estuary has been substantially reduced significant habitats and habitat functions remain. These have been described in various publications that were not cited, and apparently not consulted, in preparing the draft GSP for the Mound Basin. For an overview of the species that currently utilize the lower Santa Clara River and Santa Clara River Estuary, *see* Stillwater Sciences (2011a) Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries. Additional habitat and species information on the Santa Clara River Estuary can be can be found in Stillwater Sciences (2011b) Geomorphic Assessment of the Santa Clara River Watershed: Synthesis of the Lower and Upper Watershed Studies and CBEC (2015), Santa Clara River Estuary Habitat Restoration and Enhancement and Feasibility Study: Existing Conditions Technical Report, and Kelley (2004), Information synthesis and priorities regarding steelhead (*Oncorhynchus mykiss)* on the Santa Clara River." p. 148

Figure 5. Lower Santa Clara River – Looking northwest from Harbor Boulevard 11-4-04

The Santa Clara Estuary is known to support rearing juvenile steelhead (Kelley 2008). Steelhead that rear with in estuary have the potential for accelerated growth because of the abundance of food sources in the estuary; this accelerated growth prior to entering the ocean has been shown to increase ocean survival and growth (Bond 2006, Hayes, *et al*. 2008,).

The necessity of addressing the estuary is corroborated through studies that indicate the Santa Clara River Estuary is hydrologically connected to the upper aquifers within the Oxnard Subbasin (whether semi-perched, or simply shallow groundwater aquifers). According to a water balance assessment conducted by Stillwater Sciences (2011a, 2011b) for the fall/winter period of 2010, "groundwater was estimated to contribute approximately 15% of the inflow volume . . ." For the summer/spring 2010 period, "the groundwater contribution was estimated at 10 percent . . .". The Stillwater study also indicates that in the "Santa Clara River reach upstream of the estuary, groundwater provides the dry summer baseflow, if it exists, and is a quarter of the winter flow, based on the 2010 water year assessment." (TNC 2017, pp. 3-4).

The current conditions described in the TNS study and reflected in the Draft GSP do not represent the unimpaired groundwater elevations or surface flow conditions with the boundaries of the Mound Basin. Groundwater (whether semi-perched, or simply shallow groundwater aquifers) can also contribute to surface flows, influencing in the timing, duration, and magnitude of surface flows, particularly base flows. Groundwater that only seasonally supports surface flows can also contribute to the life-cycle of migratory fishes, such as steelhead, that can make use of intermittent flows for both migration and rearing.

Figure 6. Santa Clara River Estuary – Looking southwest from Harbor Boulevard 8-21-21

The Draft GSP also relies heavily on the Nature Conservancy's guidance for GDE analysis (TNC 2018, 2019, 2020)   According to this guidance, GDE are defined on their dependence on groundwater for all or a portion of their water needs. This method involves mapping vegetation that can tap groundwater through their root systems, assessing where the depth of groundwater is within the rooting depth of that vegetation, and mapping the extent of surface water that is interconnected with groundwater. The method used by The Nature Conservancy in identifying GDE is based on statewide data on "vegetation known to use groundwater", and therefore does not adequately reflect the uses made of groundwater by other biological resources, such as seasonal migration of fishes, or other organisms such as invertebrates that have differing life-cycle than plants (TNC 2018, 2019, 2020). While changes to riparian or other aquatic vegetation is an important component in assessing the ecological health aquatic habitats (Capelli and Stanley 1984, Faber *et al*. 1989), as it is used in the Draft GSP, it essentially as a substitute for other metrics, *e.g.,* such as measured effects on surface flows, or depth or extent of pool habitat (including estuarine habitat) in response to artificial depletion of groundwater levels.

In addition to supplying water to the root zone of plants, groundwater can also contribute to surface flows, influencing the timing, duration, and magnitude of surface flows, particularly base flows. These baseflows provide essential support to aquatic invertebrates, avian fauna, and fish species, including native resident and anadromous fishes.[4] Groundwater that only seasonally supports surface flows can still contribute to the life-cycle of migratory fishes, such as steelhead, and other native aquatic species. We would note that the pattern of alternating perennial and intermittent/or ephemeral surface flows are known as an "interrupted" surface flow regime, and is common in southern California watersheds, particularly where groundwater play a role in maintaining surface flows. These surface flows are important for juvenile *O. mykiss* attempting to emigrate out of the Santa Clara River watershed. Interrupting the timing, magnitude, and duration of these flows as a result of groundwater extraction can be deleterious to juvenile *O. mykiss*, and this potential effect should be addressed in the revised Draft Memorandum.

Figure 7. Santa Clara River Steelhead Smolts – From Santa Clara River Estuary 9-17-10

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[4] The Santa Clara River also supports the anadromous Pacific lamprey (*Entosphenus tridentatus*) which currently falls under the jurisdiction of the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife (Reid 2015, Booth 2015, 2017).

It should also be recognized that groundwater levels can be and often are exacerbated by groundwater extractions, as well as droughts. One of the primary purposes of SGMA is to identify these anthropogenic effects on groundwater levels (and the related GDE) so that groundwater resources may be managed in a way to protect all beneficial uses of groundwater, including fish and wildlife, such a southern California steelhead (as well as other native aquatic resources). Therefore, when revising the Draft GSP, every effort should be made to ensure that (1) all anthropogenic effects on the amount and extent of groundwater are properly and accurately cataloged, (2) practices are defined to remedy the cataloged effects on GDE, and (3) the practices are instituted and the effects adaptively managed to ensure GDE receive sufficient protection in accordance with the SGMA.

In addition to designating critical habitat for the federally listed endangered Southern California Steelhead DPS, NMFS identified intrinsic potential habitat in the watershed for this species as part of its recovery planning process (*See* Figure 3). As noted above, this habitat includes migration corridors to spawning and rearing habitat. Within the Mound Basin, NMFS identified intrinsic potential habitat in lower Santa Clara River and Santa Clara River Estuary. The ability of these habitats to provide a migratory corridor to spawning rearing opportunities (including within the Santa Clara River Estuary) has been negatively affected by surface water diversions and groundwater extractions. Reducing the connectivity between the mainstem of the Santa Clara River and the Santa Clara River Estuary impairs the intrinsic potential of these designated critical habitats. Restoring and maintaining surface hydrologic connectivity for steelhead attempting to migrate to or emigrate out of these major tributaries to the middle and lower reaches of the Santa Clara River is an important objective of NMFS's Southern California Steelhead Recovery Plan.

Ensuring groundwater recharge (and control of groundwater extraction for out-of-stream uses) can be an important mechanism for protecting base flows that are critical for the rearing phase of juvenile steelhead (as well as other native aquatic resources). Maintaining groundwater levels can serve as a buffer against projected climate change effects on stream flow. For a recent assessment of the effects of climate change of mean and extreme river flows, and effects of over pumping of groundwater basins on stream flow, *see* Burke *et al.* (2021), Gudmundsson *et al*. (2021), Jasechko (2021).

While groundwater-influenced flows by themselves may not be sufficient to support perennial flows in the lower Santa Clara River, or maintain appropriate water levels in the Santa Clara River Estuary, they can nevertheless support seasonal use of this reach of the Santa Clara River for migratory or rearing purposes, depending on the amount and timing of annual rainfall and runoff and the groundwater elevation. Recognition of these GDE should be explicit, and the GSP should ensure that these GDE are not unreasonably impacted by groundwater extraction from the Mound Basin.

The statements that "neither geologic units [*i.e.*, shallow alluvial aquifer and stream terrace deposits] has any know groundwater extractions within the Mound Basin" and "there is not significant evidence for interactions between the groundwater in the principal aquifers and shallow groundwater" is not supported by the analysis or the applicable regulations. As noted above, while there may be no regular withdrawals form the shallow alluvial aquifer, withdrawals from the deeper geologic units can, because of the fault discontinuities, create a hydraulic connection between aquifers and “aquitards”. Lowering the hydraulic head in deep aquifers will induce a vertical downward movement of groundwater from the shallow aquifer, which in turn, is hydraulically connected to the Santa Clara River and the Santa Clara River Estuary.

The Draft GSP notes that:

> Given the possible, but likely limited, connection between Mound Basin shallow groundwater and the iGDEs, Area 11 is retained as a GDE pursuant to TNC’s ‘precautionary principle’ (TNC 2018). However, given the lack of potential for significant impacts to the GDE by principle aquifer pumping, Area 11 will not be considered further in the development of sustainable management criteria for the principal aquifers. p. 8.

And adds:

> “However, the GSP will include a management action to monitor well permit applications for proposed uses of shallow groundwater in the vicinity of Area 11. If any shallow wells are proposed, MBGSA will require the applicant to evaluate impacts to the Area 11 GDEs pursuant to the California Environmental Quality Act prior to issuing a permit. Proposed uses that would have a significant impact to Area 11 GDEs would be required to mitigate those impacts as a condition of MBGSA permit approval” p. 8

These statements warrants several comments:

First, the TNS “precautionary principle” is focused, as is the general approach, on GDE that are defined largely by vegetative characteristics, and does not provide specific guidance for other types of GDE such as aquatic habitats that are dependent in or in part on groundwater inputs, such as the lower Santa Clara River and the Santa Clara Estuary;

Second, the conclusion that there is little potential for significant impacts to the Area 11 GDE (or the other 10 GDE within the Mound Basin) is not supported by the evidence presented in the Draft GSP, and in fact is inconsistent with the evidence (see, in particular, the longitudinal cross-section A-A’ in Figure 3.1-05 of the Draft GSP); and

Third, the related proposal to limit consideration of impacts only to wells drawing directly from the shallow alluvial aquifer overlying the Mound Basin is not consistent with the requirements of SGMA. The proposal to rely on the procedures of the California Environmental Quality Act (CEQA) to identify and mitigate any impacts is also inappropriate. CEQA is not a substitute for SGMA (Belin 2018, Rohde *et al*. 2018, California Department of Fish and Wildlife 2019)

GSPs are required to: a) identify and consider impacts to GDE; b) consider all beneficial uses and users of groundwater; c) identify and consider potential effects on all beneficial uses and users of groundwater; d), establish sustainable management criteria that avoid undesirable results, including depletion of interconnected surface waters that have a significant and unreasonable adverse impact on the beneficial uses of surface waters (including instream beneficial uses), e) describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters; and f).account for groundwater extraction for all uses or sectors, including wetlands such as those associated with the lower Santa Clara River and Santa Clara River Estuary. (23 CCR, Sections 354.10 et. Seq.)

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City of San Buenaventura, Draft Mound Basin GSP Comments – Informal 10/21/2021

67

Global Comments

Please update references to City's most recent UWMP, CWRR, and WSECP.

68

ES-1, page ES-iii

"Other sources of water supply for the Basin include groundwater pumped from City of Ventura wells located in the adjacent Santa Paula and Oxnard Basins and from the Upper Ventura River Basin (not an immediately adjacent basin), and surface water imported from the Ventura River Watershed, which is purchased from Casitas MWD. Although Mound Basin groundwater is an important source of water supply for the communities located within the Basin, the communities are not considered to be "dependent" on Mound Basin groundwater because it is only one component of the City's water supply portfolio. In contrast, agricultural beneficial users are heavily dependent on groundwater pumped from the Mound Basin as they currently do not have an alternative water supply."

For the first sentence above, the City's Ventura River water should be characterized as subsurface water extracted from shallow groundwater wells in the Upper Ventura River Basin.

For the second sentence above, the City *is* dependent on the Mound Basin groundwater. The sentence should be revised to state that, "The communities located within the Basin rely on Mound Basin groundwater, even though the City does have other sources of water supply in its water supply portfolio." For the third sentence, the phrase "in contrast," should be deleted.

69

Table ES-1, page ES-vii

The term "Change in Storage" should be clarified to mean change in storage available, as opposed to a change in the amount of groundwater in storage. Upon first use, please add a footnote clarifying the meaning for the non-technical reader, and please note that this applies to the use of that term throughout the GSP.

70

Acronyms and Abbreviations, page xx

Please change the definition of "Ventura Water" to "the City of Ventura's water and wastewater department"

71

2.1.4 Legal Authority, page 5

Comment also from MBGSA public hearing on 11/11/21

Please replace the paragraph on the City of San Buenaventura with the following:

"The City of San Buenaventura (usually referred to as Ventura), located on the shore of the Pacific Ocean in western Ventura County, was founded as a Spanish mission in 1782 and incorporated as a town in 1866 and is the county seat of Ventura County. The City administers land use within its municipal boundaries and is the largest land use jurisdiction within the Basin. Ventura Water (the City of Ventura's water and wastewater department) provides retail potable water service within the City limits and portions of unincorporated Ventura County that meet the City's policy for water connections outside City limits (Municipal Code Section 22.110.055). The City's potable water supply is derived from a variety

71 of sources, including Mound Basin groundwater. Sources located outside of the Mound Basin include groundwater pumped from the adjacent Santa Paula and Oxnard Basins, subsurface water from the Ventura River (Upper Ventura River Valley Basin), and Lake Casitas (Casitas Municipal Water District [Casitas MWD]). The City also provides recycled water from the Ventura Water Reclamation Facility (VWRF). The City operates its water supply system by utilizing a conjunctive use operating procedure. The City relies more heavily on surface water sources (such as the Ventura River and Lake Casitas) during wet years while letting groundwater sources rest. During dry years, when the surface water sources are reduced, the City relies more heavily on groundwater sources to meet demands. Conjunctive use of groundwater sources is limited by the requirement to maintain long-term production from the groundwater basins within their safe or operational yield. Conjunctive use also requires treatment and blending ratios to meet water quality goals. The City also has an entitlement from the California State Water Project (SWP) of 10,000 acre-feet per year (AF/yr). To date the City has not received any of this water because there are no existing facilities to get the water directly into the City's distribution system. However, the City is currently working on the design of the State Water Interconnection Project that will enable the City to receive its State Water allocation through a connection to Calleguas Municipal Water District. Additionally, the City is currently in the planning and design phases for the proposed VenturaWaterPure Program, which includes diversion of tertiary treated effluent to a new Advanced Water Purification Facility for potable reuse. Construction of these Projects is expected to begin in 2023."

72 **2.2.1, page 7**

Please change this sentence: "Sources of water for the M&I sector in Mound Basin include local groundwater pumped from City of Ventura wells in the Basin, groundwater pumped by the City of Ventura from the adjacent Santa Paula and Oxnard Basins and from the Upper Ventura River Basin (not an immediately adjacent basin), and surface water imported from the Ventura River Watershed, which is purchased from Casitas MWD."

To the following: "Sources of water for the M&I sector in Mound Basin include local groundwater pumped from City of Ventura wells in the Basin, groundwater pumped by the City of Ventura from the adjacent Santa Paula and Oxnard Basins, subsurface water pumped by the City from the Ventura River / the Upper Ventura River Basin (not an immediately adjacent basin), and surface water purchased from Casitas MWD."

73 **2.2.1, page 8**

"Although Mound Basin groundwater is an important source of water supply for the communities located within the Basin, the communities are not considered to be "dependent" on Mound Basin groundwater because it is only one component of the City's water-supply portfolio."

The City is dependent on Mound Basin groundwater. Please modify accordingly.

74 **2.2.2.2, page 9**

Update reference to City's Urban Water Management Plan and Water Shortage Event Contingency Plan to 2020.

75 **2.2.3.1, page 9**

Comment also from MBGSA public hearing on 11/11/21

75 Comment also from MBGSA public hearing on 11/11/21

Replace reference to “Oxnard” Subbasin in the last full paragraph on Page 9 with “Mound” Subbasin.

76 **2.2.3.2, page 18** Comment also from MBGSA public hearing on 11/11/21

Please add the following sentence: “Additionally, groundwater production wells within the City limits of the City of Ventura require a water well agreement with the City of Ventura pursuant to Chapter 8.150 of the San Buenaventura Municipal Code.”

77 **Page 21** Comment also from MBGSA public hearing on 11/11/21

Typo in City of San Ventura – should be City of San Buenaventura.

78 **Section 3.1.4.4**

We discussed potential issues with the City well depictions. Please review the text and update as you see appropriate.

Appendix G

Assessment of Shallow Alluvial Deposits and Interconnected Surface Water in the Mound Basin

MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

Appendix G

Assessment of Shallow Alluvial Deposits and Interconnected Surface Water in the Mound Basin

Table of Contents

List of Figures

1.0 Introduction

This appendix was prepared in response to comments on the draft version of the Mound Basin Groundwater Sustainability Plan (Draft GSP) that was released for public review in June 2021. In general, the comments received from several resource agencies and non-governmental organizations expressed concerns about the absence of sustainable management criteria (SMC) and limited monitoring of the Shallow Alluvial Deposits to address concerns about groundwater dependent ecosystems (GDEs, both riparian and aquatic), including the "depletions of interconnected surface water" sustainability indicator. The Draft GSP explained that the riparian GDEs may, in some cases, utilize groundwater from the Shallow Alluvial Deposits (particularly within the floodplain of the Santa Clara River). Similarly, the Draft GSP stated that the Shallow Alluvial Deposits discharge minor amounts of groundwater to Santa Clara River and its estuary. However, the Draft GSP also explained that there is no current or planned groundwater extraction from wells screened in the Shallow Alluvial Deposits and that groundwater extractions from the deep, confined aquifers of the Basin do not materially affect groundwater levels in the Shallow Alluvial Deposits or surface flows in the Santa Clara River. For this reason, there are no impacts to the riparian and aquatic GDE beneficial uses that needed to be considered during SMC formulation. Similarly, owing to the lack of impacts, the need for detailed monitoring of Shallow Alluvial Deposits and Santa Clara River flows is limited. In review of the comments, it was clear that the Draft GSP could be improved by providing more information about groundwater conditions in the Shallow Alluvial Deposits and further information to support the conclusion that shallow groundwater levels and Santa Clara River flows are not materially affected by groundwater extraction in the Mound Basin. Hence, the development of this appendix.

The purpose of this appendix is to provide additional documentation of the technical data that support the conclusions that the Shallow Alluvial Deposits hydrostratigraphic unit (HSU) is not a principal aquifer and that that shallow groundwater levels and Santa Clara River flows are not materially affected by groundwater extraction in the Mound Basin. Specifically, this appendix provides the following information:

1) The characteristics of the Shallow Alluvial Deposits HSU and explanation of why it is not considered a principal aquifer in Mound Basin.
2) Additional evidence supporting the conclusion that there is a lack of material hydraulic connection between the shallow groundwater with the much deeper principal aquifers used for water supply in Mound Basin (the Mugu and Hueneme Aquifers).
3) Additional evidence supporting the conclusion that there is a lack of material hydraulic connection between the Santa Clara River (and its estuary) and the principal aquifers used for water supply in Mound Basin (the Mugu and Hueneme Aquifers).

These topics are meant to provide further explanation as to why the Shallow Alluvial Deposits HSU is not a principal aquifer and why SMC included in the GSP do not have significant effects on beneficial uses of shallow groundwater and interconnected surface water in the Mound Basin GSP. This appendix addresses the approximately 1-mile reach of the Santa Clara River within Mound Basin between the estuary and the Oxnard Basin boundary, as shown on Figures G-1 and G-2, where a GDE has been identified. The sources of data and interpretations provided in this appendix largely consist of the references cited in the Draft GSP document and the groundwater modeling conducted by United Water Conservation District (United) in support of GSP development. Additional sources of information that were not referenced or included in the Draft GSP are referenced in this appendix.

2.0 Comparison of Shallow Alluvial Deposits to Principal Aquifer Criteria

The Sustainable Groundwater Management Act (SGMA) defines "principal aquifers" as "aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems." Review of hydrogeologic studies ranging in publication date from six decades ago (DWR, 1959; John F. Mann & Associates, 1959) to just 1 year ago (Hopkins, 2020) indicate that groundwater from the Shallow Alluvial Deposits of Mound Basin has rarely, if ever, been extracted for water supply. Groundwater-use data from Ventura County and United confirm that no significant groundwater extraction has occurred in the Shallow Alluvial Deposits in the available period of record (starting in 1980; included in the GSP dataset submitted to DWR). This appears to be because these shallow deposits are thin, discontinuous, and provide unreliable quantity and quality of groundwater due to natural conditions; specifically, the depositional history and environments for the sediments present in the shallow zone, exacerbated by the lack of hydraulic connection of these deposits with deeper aquifers that could otherwise provide a significant source of acceptable quality groundwater.

United and a few other investigators (referenced below) have occasionally referred to the shallow, relatively coarse-grained Holocene alluvial fan deposits, stream-terrace deposits, and active wash (or floodplain) deposits along the Santa Clara River and smaller barrancas in the basin as an "aquifer." However, the Shallow Alluvial Deposits in Mound Basin have never been reported to store, transmit, or yield significant or economic quantities of groundwater to wells or springs, and the most recent comprehensive investigation of the lower Santa Clara River to date (Stillwater Sciences, 2018) indicates that the contribution of groundwater from this HSU to surface water is small compared to other sources of surface flow; this comports with the GSP water budget calculations (GSP Section 3.3), which are discussed further below.

Based on these assessments and comparisons, in addition to the review of historical references below, the Shallow Alluvial Deposits HSU does not fit the definition of a principal aquifer.

2.1 Review of Historical References to the Shallow Alluvial Deposits HSU

As was noted in the GSP, the Shallow Alluvial Deposits HSU is composed of moderately to poorly sorted interbedded sandy clay with some gravel (See GSP Section 3.1). An early comprehensive investigation of hydrogeologic conditions in the groundwater basins along the Santa Clara River (John F. Mann Jr. & Associates, 1959) did not recognize the Shallow Alluvial Deposits within Mound Basin as an aquifer, nor were extraction rates reported from the depth-equivalent "Semi-perched Aquifer" in the adjacent Oxnard Basin. Also in 1959, DWR's Bulletin No. 75 noted that the alluvial deposits in Mound Basin "consist of yellow clay that has intercalated lenses of sand and gravel," and noted that the upper part of the San

Pedro Formation (which includes the Hueneme and Fox Canyon Aquifers) “form the principal sources of ground water in this basin.”

In 1972, Geotechnical Consultants, Inc. (GTC), conducted a hydrogeologic investigation of the Mound Basin “for the purpose of locating well sites for additional groundwater supplies for the City of San Buenaventura.” GTC did not identify the Shallow Alluvial Deposits as a potential source of developable groundwater in their report. The GTC (1972) investigation tabulated water quality data for wells less than 300 feet deep, noting that the data indicated the presence of “exceptionally high concentrations of sulfate, chloride, nitrate, boron, and total dissolved solids (TDS) for all time periods considered” (1950-1969), implying that groundwater in the Shallow Alluvial Deposits and underlying clay-rich strata were unsuitable for water supply purposes.

In 1996, Fugro West, Inc. (Fugro), provided an update on an investigation they were conducting on behalf of the City of Ventura for further development of groundwater supplies in Mound Basin. In their update report, Fugro stated that the “aquifers in Mound Basin are confined by an approximate 300-foot-thick layer of low permeability, aquiclude materials . . . Recharge occurs as subsurface underflow from the Santa Paula Basin and as local recharge from the Ventura foothills” (Fugro, 1996). Fugro’s update report did not mention the Shallow Alluvial Deposits as an aquifer.

In the 1990s, the U.S. Geological Survey (USGS) investigated hydrogeologic conditions throughout the Santa Clara River and Calleguas Creek watersheds, including Mound Basin, for the purpose of developing a regional-scale groundwater flow model (Hanson et al., 2003). The USGS investigation report did not describe the Shallow Alluvial Deposits specifically within Mound Basin as an “aquifer,” but did extend the area they mapped as “Alluvium (Shallow Aquifer)” across their entire model domain, which includes the Mound Basin. They noted that “With the exception of recent coarse-grained channel deposits along the Santa Clara River and Calleguas Creek, the thin layer of Holocene deposits that are not coincident with minor tributaries are relatively fine grained and relatively low in permeability,” indicating that they would not likely yield much water to wells, springs, or surface water systems. Hanson et al. (2003) added that “water quality (in the shallow aquifer) is poor throughout most of the Oxnard Plain and Pleasant Valley subbasins and consequently few wells are perforated opposite this aquifer.” Water quality in the Shallow Alluvial Deposits in Mound Basin was not explicitly called out by Hanson et al. (2003) in their report; however, data reviewed for this GSP demonstrate that shallow water quality conditions are also poor in the Mound Basin. As noted above, this line of thinking (that poor groundwater quality and yield makes the shallow groundwater unusable as an aquifer for water supply) applies to the Mound Basin as well as the Oxnard and Pleasant Valley Basins.

In 2018, Stillwater Sciences conducted a detailed analysis of “Physical and Biological Conditions of the Santa Clara River Estuary” (the estuary is abbreviated as “SCRE” throughout the Stillwater Sciences report), including investigation of groundwater conditions within the Shallow Alluvial Deposits underlying and adjacent to the lower Santa Clara River in Mound Basin and the adjacent Oxnard Basin. Stillwater Sciences (2018) notes that, ”The lowermost reach” (of the Santa Clara River) “leading into the SCRE supports perennial, albeit low volume, flow during most water-year types. This baseflow, which is driven by inputs from the semi-perched aquifer, is partly enhanced by seasonal agricultural runoff, particularly on the northern floodplain.” The Stillwater Sciences reference to the Semi-perched Aquifer in this sentence suggests that the source of the observed perennial flow is primarily upstream from Mound Basin, in Oxnard Basin, where the Semi-perched Aquifer is present. As discussed later in this appendix, the quantity of groundwater discharged from the Shallow Alluvial Deposits in Mound Basin to the Santa Clara River is very small in relation to other sources.

The most recent investigation of groundwater production and hydrogeologic conditions in Mound Basin was conducted by Hopkins Groundwater Consultants, Inc. (Hopkins), in 2020. The Hopkins investigation refers to "shallow confined zones," sometimes referred to in the Hopkins report as a "shallow aquifer," that are not used as a source of groundwater for water supply in the basin, and therefore do not meet the SGMA definition of a principal aquifer. Hopkins (2020) further notes that the HSUs used for water supply in Mound Basin are those HSUs identified in the GSP as the Mugu, Hueneme, and Fox Canyon aquifers.

In summary, historical investigators of the Mound Basin have not identified the Shallow Alluvial Deposits as an important water-bearing unit in the Mound Basin that would fit the SGMA definition of a "principal aquifer."

2.2 Distinct Lithologic Facies of the Shallow Alluvial Deposits

As noted in Section 3.1 of the GSP, the Shallow Alluvial Deposits HSU is present across much of Mound Basin (absent only in the foothills in the north part of the basin). Considered in their entirety, the thickness of these deposits ranges from 50 to 100 feet, and they consist mostly of Holocene alluvial fan deposits (USGS, 2003a, 2003b, 2004; Gutierrez et al., 2004), including moderately to poorly sorted interbedded sandy clay with some gravel. Such poorly sorted deposits dominated by clay are not a suitable target for groundwater development, explaining why no wells are known to target the Shallow Alluvial Deposits in Mound Basin for water supply. However, some important distinctions are worth noting with regard to the lithologic facies present within the near-surface deposits along the Santa Clara River in Mound Basin.

Stillwater Sciences (2018) reported that the piezometers installed for the City of Ventura's estuary studies along the Santa Clara River encountered varying lithologies, including silty sand, gravelly sand, and clay layers, as well as clayey, silty, and gravelly sands, with highly variable hydraulic conductivities (ranging from 1 to 100 feet per day). Geologic maps (USGS, 2003a, 2003b, 2004; Gutierrez et al., 2004) indicate that surficial and near-surface sediments in this area consist of the following (shown on Figure 3.1-03 of the Draft GSP; attached herein as Figure G-3):

- Recent active wash deposits within the main channel of the Santa Clara River containing abundant sand and gravel, and up to 40 feet thick.
- Up to three levels of Holocene stream terrace deposits adjacent to and within ½ mile of the north and south banks of the Santa Clara River, including point bar and overbank deposits consisting of poorly sorted clayey sand and sandy clay with gravel, typically several feet thick, but potentially up to 20 feet thick or more in some locations.
- Holocene alluvial and colluvial deposits associated with the Santa Clara River but located ¼ to ½ mile from the river between the Holocene stream terrace deposits and the Holocene alluvial fan deposits.
- Recent artificial fill, typically less than 10 feet thick, but up to 15 feet thick in some locations, consisting of sand, asphalt, and concrete (Hopkins, 2018).

As described in Section 3.1 of the Draft GSP, some of these thin terrace and other alluvial deposits associated with the Santa Clara River can be expected to contain shallow perched zones where agricultural return flows and infiltrated rainfall have collected above low-permeability layers (e.g., clay). Groundwater in these perched zones can flow laterally toward the Santa Clara River to contribute very small amounts (relative to the total Mound Basin groundwater budget, as described in Section 3.3 of the Draft GSP) to surface water flows or to meeting the evapotranspiration (ET) demands of vegetation near the river. In addition to water in these shallow perched zones, perched groundwater within saturated layers and lenses of the Holocene alluvial fan deposits in Mound Basin (north of the active channel and stream terrace deposits along the Santa Clara River) likely flows southward toward the river and may be able to enter the stream-terrace deposits or active channel deposits, possibly contributing to surface flows. Specific quantities of groundwater estimated by previous investigators to discharge to the Santa Clara River are discussed below.

2.3 Groundwater Discharge to the Santa Clara River

As noted in the most recent and detailed study specific to the Santa Clara River estuary (Stillwater Sciences, 2018), the Shallow Alluvial Deposits along the lower Santa Clara River in Mound Basin and the adjacent Oxnard Basin are "underlain by a clay layer, thereby disconnecting the SCRE (estuary) from the deeper subbasin aquifers…" Because the lower reach of the river is hydraulically disconnected from principal aquifers in Mound and Oxnard basins, the "low volume" of perennial baseflow observed in this reach during most years "is driven by inputs from the semi-perched aquifer" (the referenced "semi-perched aquifer" is only present in the Oxnard Basin, and is believed to discharge some groundwater to the Santa Clara River upstream from Mound Basin) and "is partly enhanced by seasonal agricultural runoff, particularly on the northern floodplain" (Stillwater Sciences, 2018).

Stillwater Sciences (2018) provided details regarding surface-water flows in the Santa Clara River and its estuary in Mound Basin, including an estimate of the quantity of groundwater discharge to surface flows in the river. Stillwater Sciences (2018) summarized flows in the portion of the river in Mound Basin as follows: "Overall, the river and SCRE (estuary) naturally experience a wide variation of flows, punctuated episodically by short-duration but intensive channel-/lagoon-adjusting flood events." They also note that "Over the long-term record, February has experienced the highest monthly flows (~750 cfs [cubic feet per second] in the lower river) while August and September have experienced the lowest flows (~1 cfs in the lower river)." The high flows (750 cfs) represent storm flows occurring during and immediately following precipitation events, usually in winter, while the low flows (1 cfs, equivalent to 724 acre-feet per year [AF/yr]) generally occur in summer and fall, and include, among other sources, a small component of groundwater discharge to surface water (Stillwater Sciences, 2018).

Stillwater Sciences (2018) estimated groundwater discharge to the Santa Clara River from Mound Basin during the period from January 2015 to December 2016 to be 0.2 to -0.3 cfs (negative values represent flow of surface water to groundwater, as recharge). These discharge and recharge quantities occurred along the area designated "North Bank Floodplain-West" in the Stillwater Sciences (2018) report, located along the north bank of the river between Harbor Boulevard and the boundary with the Oxnard Basin.

Stillwater Sciences (2018) listed other, higher-volume discharges to the Santa Clara River along other reaches of the Santa Clara River in Mound Basin as "groundwater." However, the sources for these larger discharge volumes include treated wastewater (0.7 to 1.6 cfs) from the Ventura Water Reclamation

Facility wildlife/polishing ponds ("North Bank Floodplain-Ponds"), and river bank storage changes (-5 to +5 cfs, averaging approximately 0 cfs) resulting from short-term, groundwater-surface water exchanges in response to changes in surface-water levels in the estuary following breaching or formation of the barrier berm ("South Bank Floodplain [GW-1 through GW-3]"). Stillwater Sciences (2018) also estimated "unmeasured flows" consisting of groundwater discharging to surface water in the Santa Clara River between the Victoria Avenue bridge (in Oxnard Basin) to the estuary (in Mound Basin) ranging from a minimum of 0.08 cfs (July 2017) to 2.1 cfs (2009 and 2010).

The Stillwater Sciences' (2018) summary of contributors to surface flow in the lower Santa Clara River in Mound Basin indicates that groundwater discharge from the Shallow Alluvial Deposits is a small component of total flow in the river, compared to other flow components entering and exiting Mound Basin. This conclusion is further supported by modeling, as discussed below. Moreover, a significant portion of the groundwater discharge reported above is likely tile drain and/or perched groundwater associated with agricultural return flows in the irrigated fields, which border the Santa Clara River.

Groundwater modeling conducted by United in support of GSP development (United, 2021; detailed tables, figures, and additional references provided in the main text of the GSP) indicate that groundwater discharge to the Santa Clara River within Mound Basin is typically 0.2 to 0.6 cfs during low-rainfall ("dry") years, and -2 to -3 cfs (representing recharge, rather than discharge) during high-rainfall ("wet") years (see Figure 3.3-02 of the Draft GSP for annual model-estimated groundwater/surface water exchanges in the Santa Clara River in Mound Basin; attached herein as Figure G-4). These values are much smaller than the estimated average of 197 cfs entering Mound Basin from Oxnard Basin as surface flows in the Santa Clara River from 1986 through 2019 (Draft GSP Table 3.3-02, flows converted from acre-feet).

3.0 Lack of Material Influence of Principal Aquifer Pumping on Shallow Groundwater Levels and Santa Clara River Flows

Prior investigations and available data clearly indicate negligible influence of groundwater extraction from the principal aquifers on shallow groundwater levels and interconnected surface water along the Santa Clara River within the Mound Basin.

3.1 Summary of Hydrogeologic Investigations

As described in the GSP and supported by multiple references cited in the Draft GSP (e.g., John F. Mann Jr. & Associates, 1959; GTC, 1972; Fugro, 1996; United, 2012; Stillwater Sciences, 2018; Hopkins, 2018), a 100- to 400-foot thick, low-permeability aquitard consisting largely of silt and clay referred to as "fine-grained Pleistocene deposits" separates the Shallow Alluvial Deposits from the underlying Mugu Aquifer both physically and hydraulically in the Mound Basin. A similar, albeit thinner, fine-grained zone known as the "clay cap" separates the semi-perched aquifer from the underlying Oxnard Aquifer in the adjacent Oxnard Basin (Hanson et al., 2018; United, 2018). Plate 10 in the Hopkins (2018) report, included herein as Figure G-5, provides a detailed hydrogeological cross section (F-F') depicting the stratigraphy of the Shallow Alluvial Deposits and fine-grained Pleistocene deposits under the Santa Clara River and its estuary in Mound Basin. The Mugu Aquifer occurs below the base of cross-section F-F’, separated from the Shallow Alluvial Deposits by at least 250 feet of clay and sandy clay, as determined from well and boring logs in the area.

For reference, cross-section D-D’ from the GSP, included herein as Figure G-6, depicts the depths of the HSUs in Mound Basin under the Santa Clara River and its estuary, but with less detail than shown on cross-section F-F’. From cross-section D-D’, it can be seen that the Hueneme and Fox Canyon aquifers are further disconnected from the Shallow Alluvial Deposits (compared to the Mugu Aquifer) by a maximum of 2,000 feet of vertical separation and additional aquitards. Importantly, most of the groundwater extraction in the Mound Basin is by wells screened in the Hueneme Aquifer, which is separated from the Shallow Alluvial Deposits and Santa Clara River by two aquitards that are approximately 300 to 400 feet in total thickness.

Based on calibration of its regional groundwater flow model, United (2021) estimated the horizontal hydraulic conductivity of the Shallow Alluvial Deposits to be 200 ft/d in Mound Basin, and the vertical hydraulic conductivity to be 20 ft/d. The specific yield of the Shallow Alluvial Deposits in the groundwater flow model is 15% (United, 2021). These values do not apply to localized stream terrace deposits along the Santa Clara River where shallow groundwater interconnects with the Santa Clara River and GDEs are present (i.e. GDE Area No. 11). The presence of tile drains on agricultural lands situated on the stream terrace deposits (see GSP Figures 2.1-03 and 3.1-09) suggests that the stream terrace deposits are poorly permeable and, therefore, are not considered to be an aquifer, but may contain perched groundwater zones. No estimates of the vertical hydraulic conductivity of the fine-grained Pleistocene Deposits from field investigations were found during review of available reports; however, United (2021) achieved good calibration of its groundwater flow model by applying a vertical hydraulic conductivity of 0.001 feet per day, which is a reasonable value for silt and clay deposits in alluvial aquitards (Heath, 1983). This hydraulic conductivity value is three orders of magnitude smaller than what is generally considered a minimum acceptable value for hydraulic conductivity in a water supply aquifer (1 foot per day or larger).

Given the substantial area (approximately 11,000 acres) where the fine-grained Pleistocene deposits underlie the Shallow Alluvial Deposits, even a relatively low degree of hydraulic communication between these HSUs can still allow downward infiltration of groundwater from the Shallow Alluvial Deposits to the fine-grained Pleistocene deposits. As indicated in Table 3.3-04 of the Draft GSP and the zone budget analysis below (Section 3.5), groundwater modeling indicates that approximately 1,600 AF/yr (~130 AF/month) of groundwater moved downward from the Shallow Alluvial Deposits to the fine-grained Pleistocene deposits, on average, from 1986 through 2019. The zone budget analysis (see section 3.5 below) shows the historical variability of the vertical flows (in AF/month) from layer 1 to layer 2 of the groundwater model. If this downward migration were distributed equally across the 11,000-acre extent of the fine-grained Pleistocene deposits, that would imply 0.15 AF/yr of downward groundwater flux per acre. However, most of this downward flux occurs in the central and eastern portions of Mound Basin, and much smaller vertical fluxes occur near the hydraulic low point of Mound Basin, along the lower Santa Clara River. Downward vertical flow of water across the fine-grained Pleistocene deposits does not mean that principal aquifer pumping has a significant influence on shallow groundwater levels or interconnected Santa Clara River flows, because the significant thickness and low permeability of the fine-grained Pleistocene deposits greatly limits propagation of head changes between the Shallow Alluvial Deposits and the principal aquifers and flows. This is further verified with the model sensitivity analysis below (Section 3.4).

3.2 Groundwater Elevation Data

Review of available groundwater elevation data for piezometers screened in the Shallow Alluvial Deposits and in wells screened in the principal aquifers in Mound Basin confirm that there is no discernible effect of groundwater-level declines in the principal aquifers on shallow-alluvial groundwater levels during the recent (2012-16) drought. Figure G-7 shows significant declines (up to 50 feet) in measured groundwater elevations at wells screened in the Mugu and Hueneme Aquifers in Mound Basin near the Santa Clara River during the 2012-2016 drought, while groundwater elevations in the piezometers screened in shallow alluvial or stream terrace deposits adjacent to and underlying the Santa Clara River estuary remain relatively constant near 10 feet relative to the 1988 North American vertical datum (NAVD88), with occasional sharp departures and returns from that base elevation in response to river-mouth breaching events. Locations for these wells are shown on Figure G-1. Total groundwater extractions from the Mound and Oxnard basins are also shown on Figure G-7, for reference. As shown on Figure 3.1-26 of the Draft GSP (included herein as Figure G-8), there is just one active water supply well screened in the Mugu Aquifer, and one active water supply well with an unknown screened interval, located within 1 mile of the reach of the Santa Clara River within Mound Basin. A total of 155 AF of groundwater was extracted from the Mugu Aquifer well (02N22W19M04S) in 2019 and a total of 2 AF was extracted from the unknown-screened-interval well (02N23W24F01S) during 2019, as summarized in Table 3.1-02 of the Draft GSP. Two Hueneme Aquifer wells are also located within 1 mile of the Santa Clara River in Mound Basin, but as noted above, the Hueneme Aquifer is hydraulically disconnected from the Shallow Alluvial Deposits (and Santa Clara River) not just by the fine-grained Pleistocene deposits, but also by the Mugu Aquifer and the Mugu-Hueneme aquitard. Indeed, there is no relationship between groundwater extraction in Mound or Oxnard Basins and groundwater elevations measured in the piezometers screened in the Shallow Alluvial Deposits in Mound Basin that can be discerned in Figure G-7.

In summary, the groundwater levels data demonstrate the lack of material influence of principal aquifer groundwater levels on shallow groundwater levels and, by extension, Santa Clara River flows.

3.3 Geochemical Data

As explained in the GSP (Section 3.2), geochemical data do not indicate significant interactions between groundwater in the principal aquifers and shallow groundwater. Results of a recent geochemical investigation in Mound Basin conducted by S.S. Papadopulos & Associates, Inc. (SSP&A, 2020) include the following key conclusions regarding potential interactions of surface water, shallow groundwater, and the principal aquifers of Mound Basin (which are typically present at depths of hundreds of feet below land surface):

- "There appear to be limited interactions vertically between aquifers, regardless of formation. Shallower groundwater (≤500 ft.-bgs) is geochemically- and isotopically distinct."
- "There is no evidence for significant interactions between shallower groundwater (≤500 ft.-bgs) and the Santa Clara River. In fact, δ18O and δD signatures of shallower groundwater are distinctly different than the Santa Clara River."

3.4 Numerical Modeling Analysis

The groundwater elevation and geochemical data described provide clear evidence that the principal aquifers do not materially influence conditions in the shallow alluvial deposits and Santa Clara River. Additional evaluation was completed using United's (2021) numerical model to conduct a sensitivity analysis to evaluate whether hypothetical large changes in groundwater extraction rates in Mound Basin could cause significant changes in groundwater elevations in the shallow aquifer or impact rates of shallow groundwater discharge to surface water.

The sensitivity analysis assumed changes in overall groundwater extraction rates throughout the historical and current water budget periods (January 1985 through December 2019) relative to the actual extraction rates over the same periods (base case scenario), with the following adjustments:

- 125 percent of historical/current Mound Basin extraction rates.
- 75 percent of historical/current Mound Basin extraction rates.
- No Mound Basin pumping (0 percent) during the historical/current period.

The differences in groundwater discharge to surface water under all three sensitivity runs are nearly identical to the base case (Figure G-9), suggesting that groundwater extraction in the principal aquifers has a negligible influence on groundwater levels in the Shallow Alluvial Deposits and flows in the Santa Clara River. The differences between average groundwater discharge to surface water throughout the modeled period (1985-2019) in the base case versus the sensitivity runs that assume 75 and 125 percent of historical groundwater extraction range from 15 AF/yr more to 15 AF/yr less than the base case values, respectively (15 AF/yr is equal to 0.02 cfs). As noted in Section 2.3 of this appendix, these values are a very small fraction of the total flow in the lower reach of the Santa Clara River, which ranges from 1 to 750 cfs (Stillwater Sciences, 2018). In the sensitivity run where no groundwater is extracted from Mound Basin, simulated groundwater discharge to surface water increases by 61 AF/yr (0.08 cfs), which again is a very small fraction of total flow in the lower reach of the river. The small change in simulated surface water flows demonstrates that groundwater conditions in the principal aquifers (Mugu and Hueneme aquifers), including groundwater extraction, do not materially influence surface water flows, consistent with the data summarized in preceding sections of this appendix.

The differences in groundwater elevations for the sensitivity runs compared to the base case are mostly less than 0.1 feet, except for the no-pumping sensitivity run, as shown on Figure G-10. The locations where these differences in groundwater elevations were calculated are shown on Figure G-11. In the no-pumping sensitivity run, simulated groundwater elevations in the Shallow Alluvial Deposits increase 0.2 to 0.4 feet compared to the base case. The small change in simulated shallow groundwater levels demonstrates that groundwater conditions in the principal aquifers (Mugu and Hueneme aquifers), including groundwater extraction, do not materially influence groundwater conditions in the Shallow Alluvial Deposits. The model estimated groundwater elevation changes are considered negligible and additionally are conservative because the United (2021) model may overestimate the degree of hydraulic connection between the saturated sediments in contact with the Santa Clara River and the deeper principal aquifers in Mound Basin. This is because the model uses a single layer to represent the entire thickness of the Shallow Alluvial Deposits, and therefore, the model assumes instantaneous and direct responses occur throughout Layer 1 (from land surface to the base of the Shallow Alluvial Deposits) to changes in extraction rates and recharge in deeper layers or HSUs. The Shallow Alluvial Deposits actually consist of multiple layers and lenses with varying storativity, vertical leakance, and degrees of interconnection, which buffers shallow groundwater level responses to changes in groundwater extraction rates in the principal aquifers of Mound Basin.

3.5 Zone Budget Analysis

A zone budget analysis for the baseline historical numerical model utilized MODFLOW's zone budget tool to focus on the modeled flows between the Santa Clara River and the upper layers of the model. Three zones were delineated (Figure G-12):

1. Model cells coincident with the Santa Clara River boundary condition (STR) cells within layer 1
2. Non-STR cells in layer 1
3. Layer 2 model cells

Stream leakage flows from the Santa Clara River STR cells to zone 1 were also included in the analysis, computed from the STR boundary condition package from the numerical model. Observing the top chart in Figure G-12, during most of the simulated historical period lateral flows between zones 1 and 2 are negative (flow from zone 2 to zone 1) and are generally less than 100 AF/month. During high-stage, short-term storm events, flows are positive (flow from zone 1 to zone 2), with maximum rates for two events at approximately 1,000 AF/month. Overall, the net exchange (average flow) is essentially zero (5 AF/month). The upper graph also shows that flows from zone 1 to zone 3 (vertical exchange between the groundwater cells coincident with the Santa Clara STR boundary and layer 2) are negligible. Flows from zone 2 to zone 3 are notable and are always positive (from zone 2 to zone 3; downward from layer 1 to layer 2). These downward flows are usually greater in magnitude than the lateral flows between zones 1 and 2 except during a few peak events but are overall generally small (average 136 AF/month) and unevenly distributed across the 11,000-acre extent of the layer, with the highest rates in the central and eastern portions of the model, away from the Santa Clara River. For context, the overall average rate of inflows/outflows for the combined historical and current surface water budget is ~13,000 AF/month (~160,000 AF/yr; see GSP sections 3.3.1/3.3.2, Table 3.3-02).

The bottom chart on Figure G-12 is similar to the top chart flow between zone 1 and zone 2, and similarly indicates that during most of the historical time period flow is from zone 1 to the STR boundary cells, feeding it at low volumes. During peak events, the direction reverses and the stream is providing larger volumes to the cells directly beneath. In addition, the net exchange is zero.

The zone budget analysis validates the conceptual model that the Shallow Alluvial Deposits HSU (zone 2, layer 1) is hydraulically connected to the Santa Clara River (zone 1, STR cells) with very low flow rates, but is disconnected from the deeper aquifers (zone 3, layer 2).

4.0 Conclusions

The results of this assessment are as follows:

1. The Shallow Alluvial Deposits HSU has not been considered an important water-bearing unit by historical investigators and does not meet the definition of a principal aquifer, as defined in the GSP Emergency Regulations, because MBGSA has concluded that this HSU does not store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

2. Available data and numerical modeling analysis indicate that groundwater conditions in the principal aquifers (Mugu and Hueneme Aquifers), including groundwater extraction, do not materially influence groundwater levels in the Shallow Alluvial Deposits. Therefore, groundwater-dependent ecosystems (GDEs) present in Area 11 of the GSP (i.e., GDEs associated with the Santa Clara River and its estuary) will not be materially impacted by groundwater extraction or GSP implementation and, therefore, do not need to be considered in the SMC for the GSP.

3. Available data indicate that the Santa Clara River and its estuary are interconnected with shallow groundwater present in the Shallow Alluvial Deposits. However, available data and numerical modeling analysis indicate that groundwater conditions in the principal aquifers (Mugu and Hueneme aquifers), including groundwater extraction, do not materially influence interconnected surface water flows. Therefore, depletion of interconnected surface water is not an applicable sustainability indicator for the GSP.

4. MBGSA will partner with the City of Ventura and United to collect interim shallow groundwater levels and perform a hydrogeologic study to further assess the hydraulic connection of the river with the Shallow Alluvial Deposits and the Shallow Alluvial Deposits and the deeper principal aquifers, providing further data to support the current HCM and Appendix G. The interim water level study will also analyze shallow groundwater levels against pumping data from the principal aquifers to confirm the lack of groundwater extraction impacts in the deeper principal aquifers on groundwater in the Shallow Alluvial Deposits.

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Figures

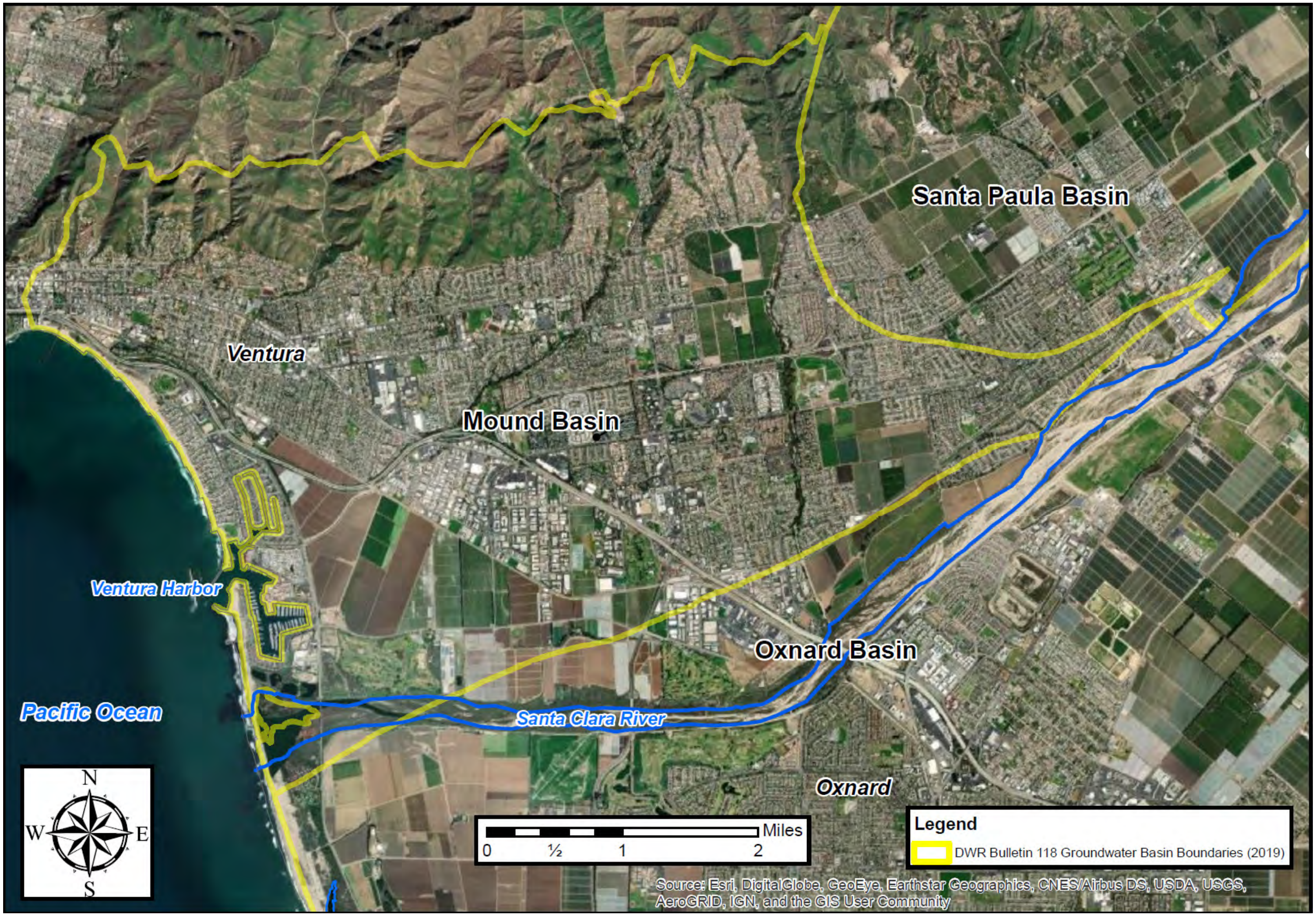


Figure G-1. Location Map for Mound Basin.

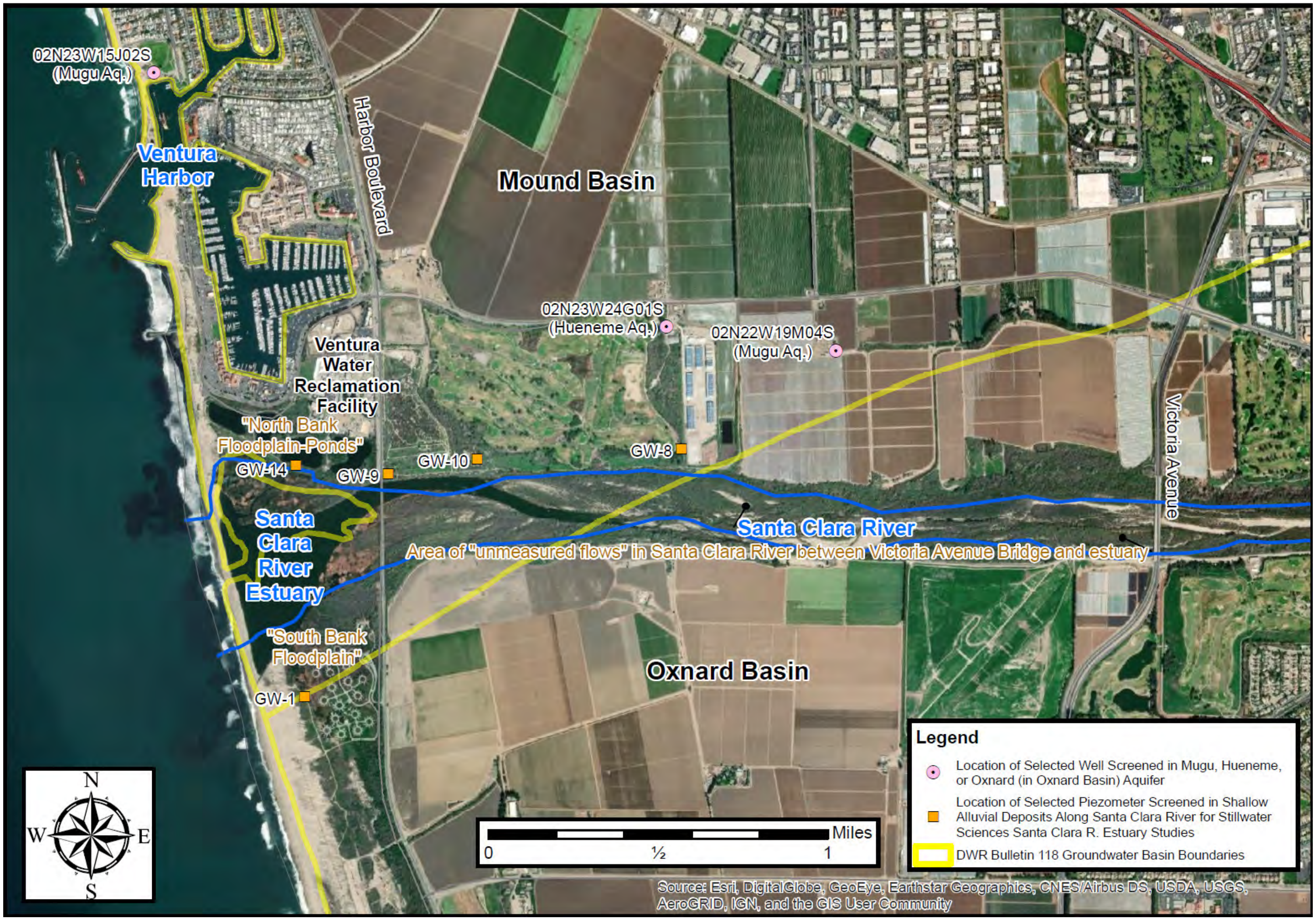


Figure G-2. Location of Selected Wells and Shallow Piezometers near Santa Clara River with Multiple Groundwater Level Measurements Reported from 2009 through 2017.

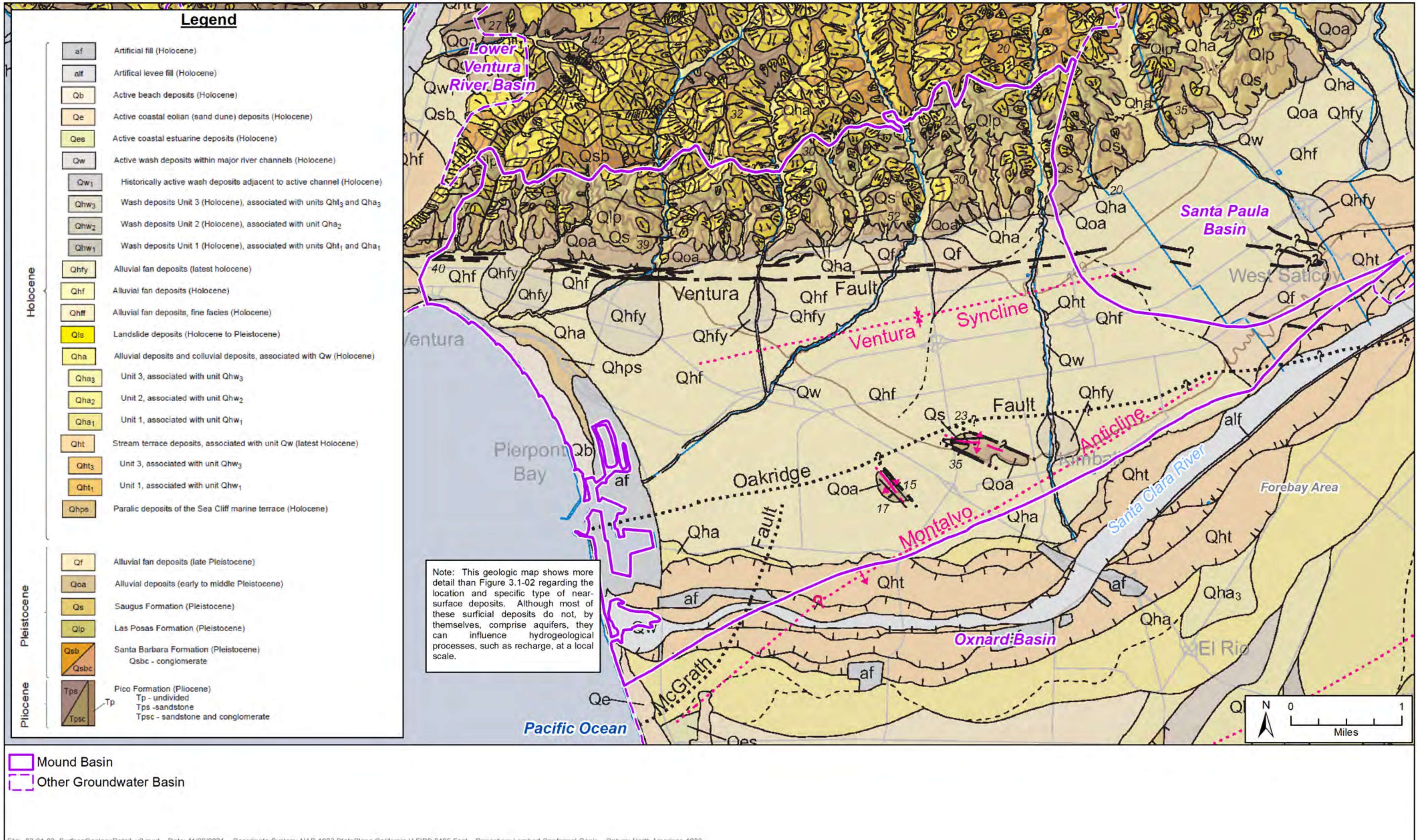


Figure G-3. Detailed Surface Geologic Map of Mound Basin, from Gutierrez et al. (2008) (Figure 3.1-03 of the Draft Mound Basin GSP).

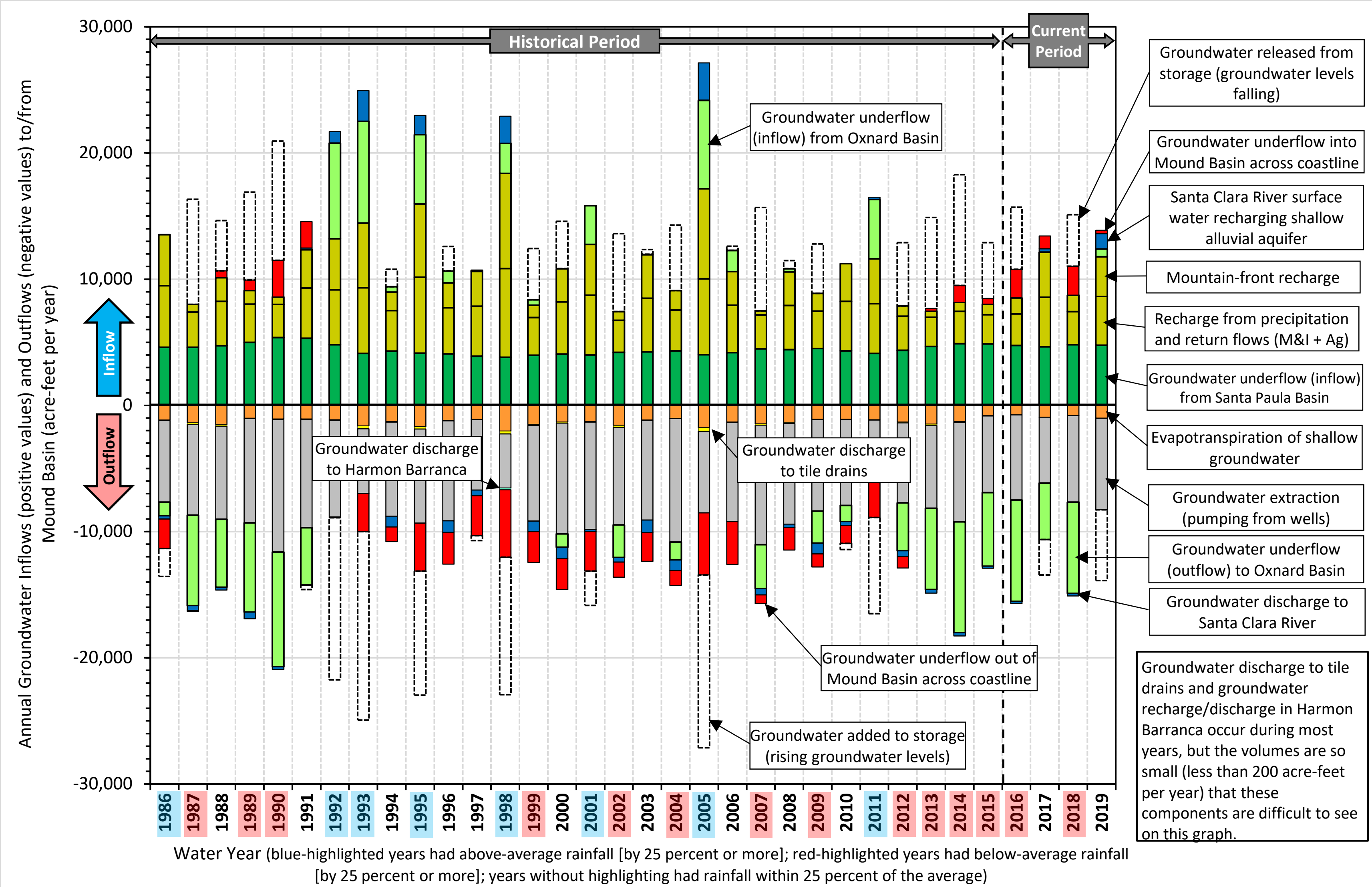


Figure G-4. Annual Groundwater Inflows (positive values) and Outflows (negative values) to/from Mound Basin, in acre-feet per year (Figure 3.3-02 from Draft GSP).

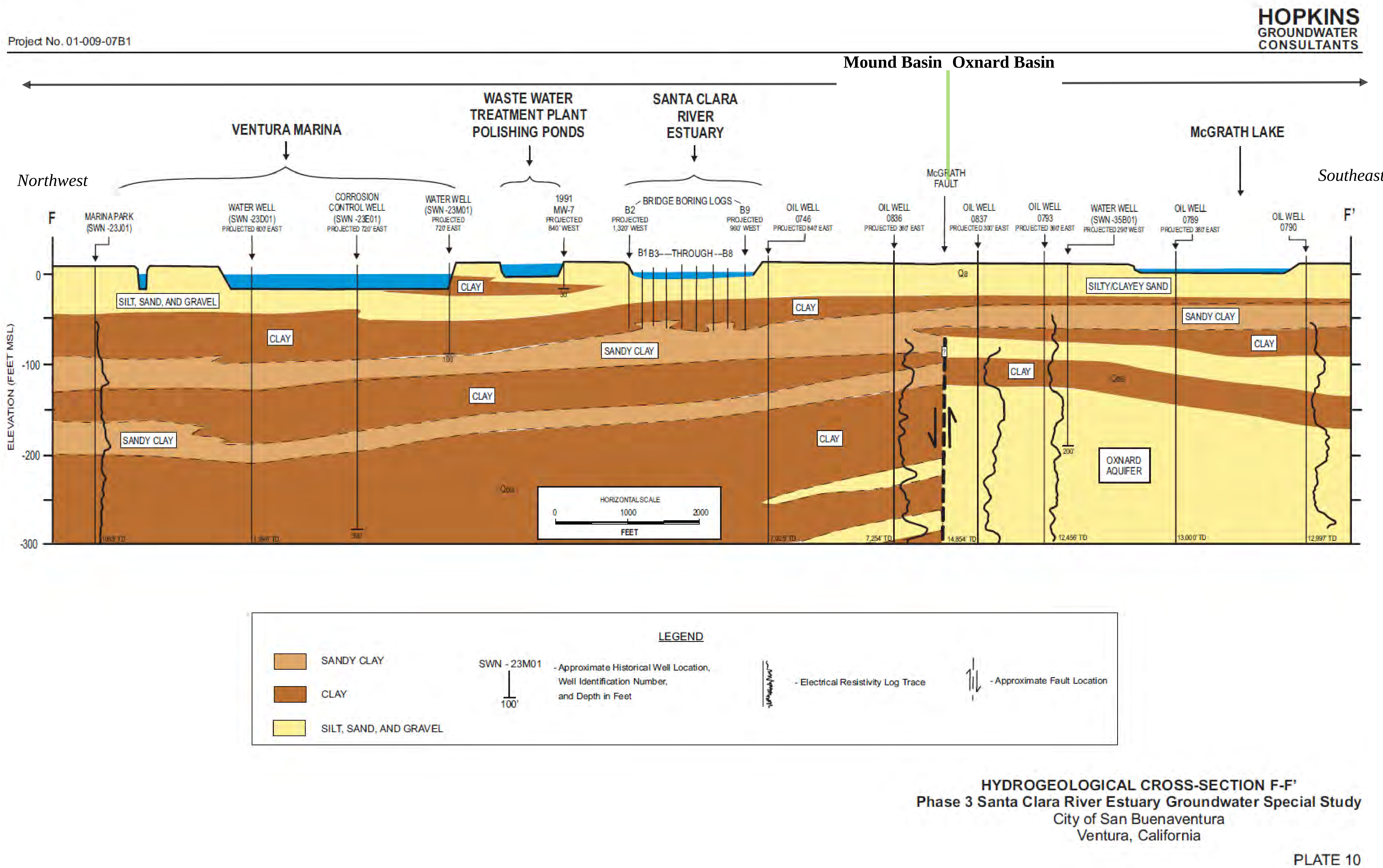


Figure G-5. Hydrogeological Cross Section F-F' from Hopkins, 2018, Showing Detailed Stratigraphy Below the Santa Clara River in Mound Basin (Plate 10 in Hopkins, 2018, report).

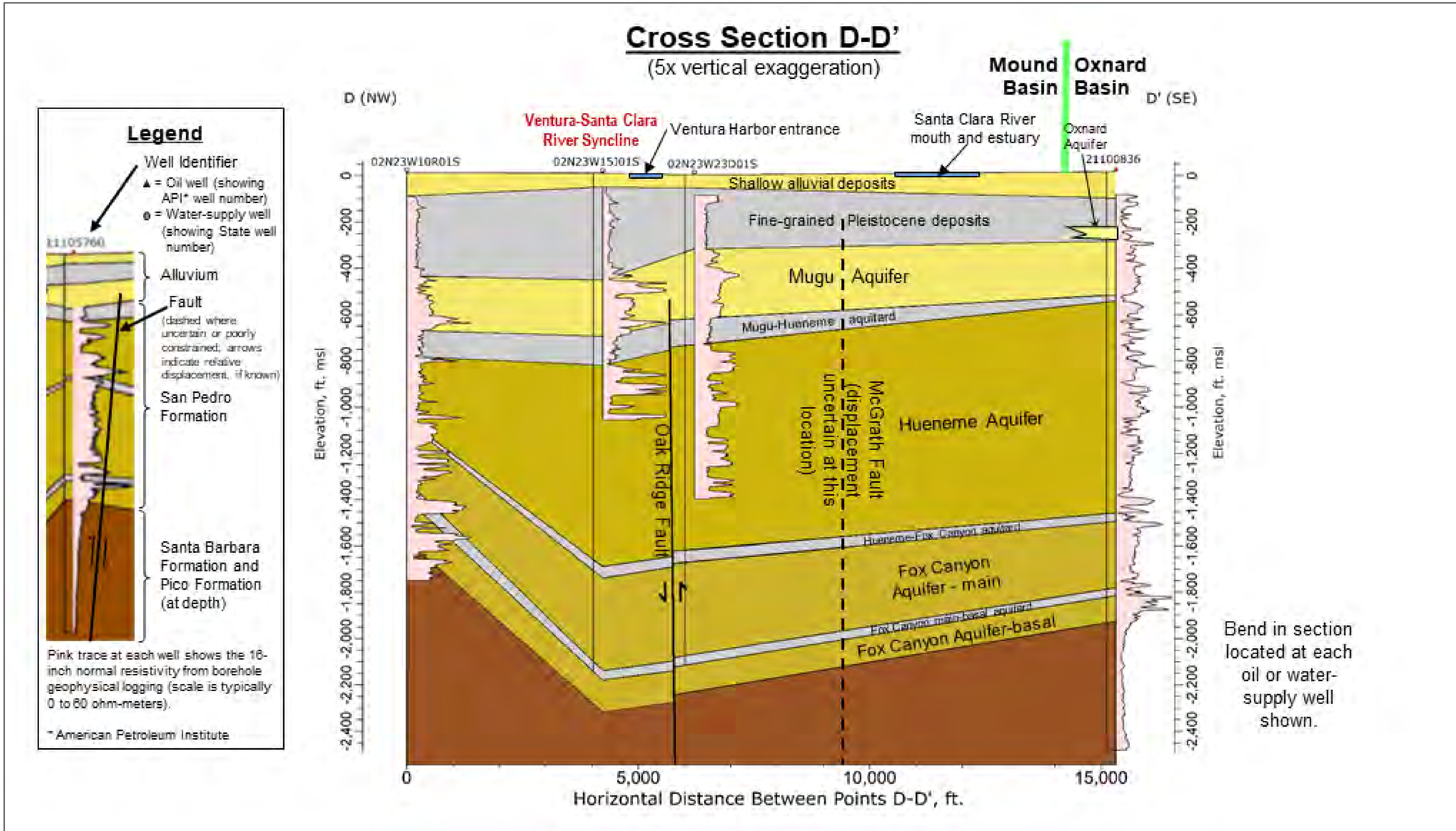


Figure G-6. Cross Section D-D' Showing Hydrostratigraphic Units below the Santa Clara River in Mound Basin (Figure 3.1-08 of the Draft Mound Basin GSP)

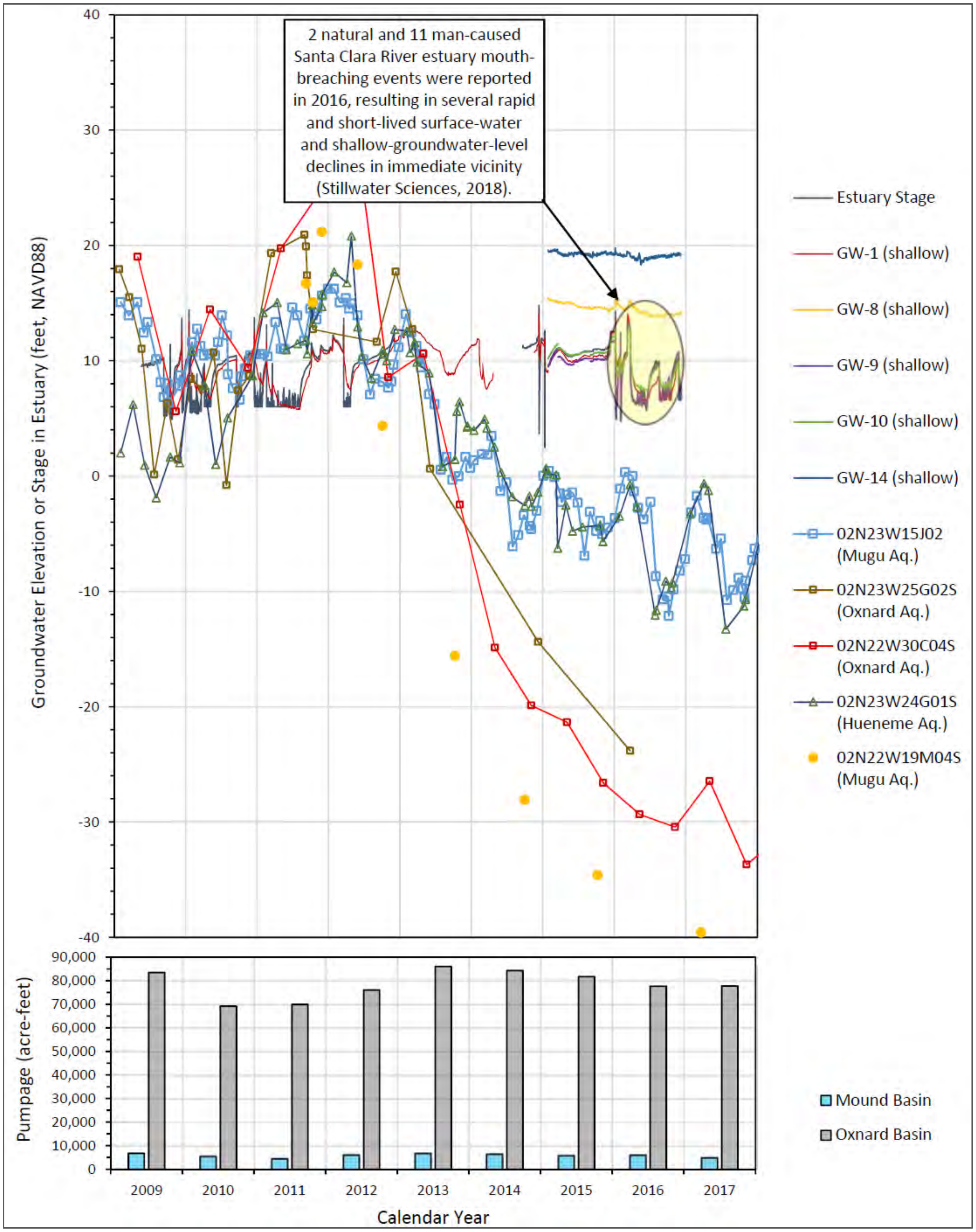


Figure G-7. Groundwater Elevations Reported for Selected Wells and Shallow Piezometers near Santa Clara River in Mound Basin, 2009-17, and Total Groundwater Extracted from Mound and Oxnard Basins

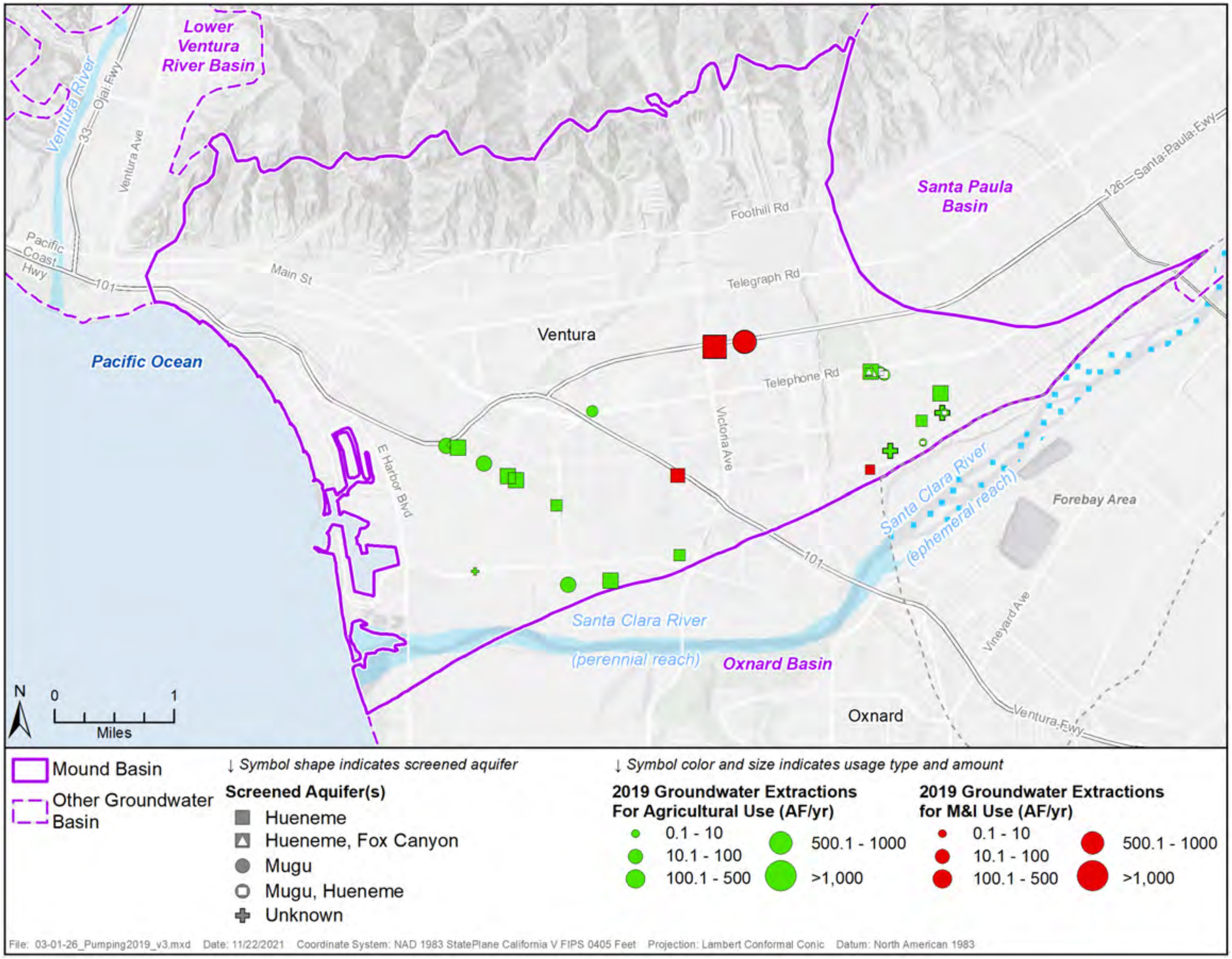


Figure G-8. Map of Active Water Supply Wells in Mound Basin, Showing Extractions in 2019 (Figure 3.1-26 of the Draft Mound Basin GSP).

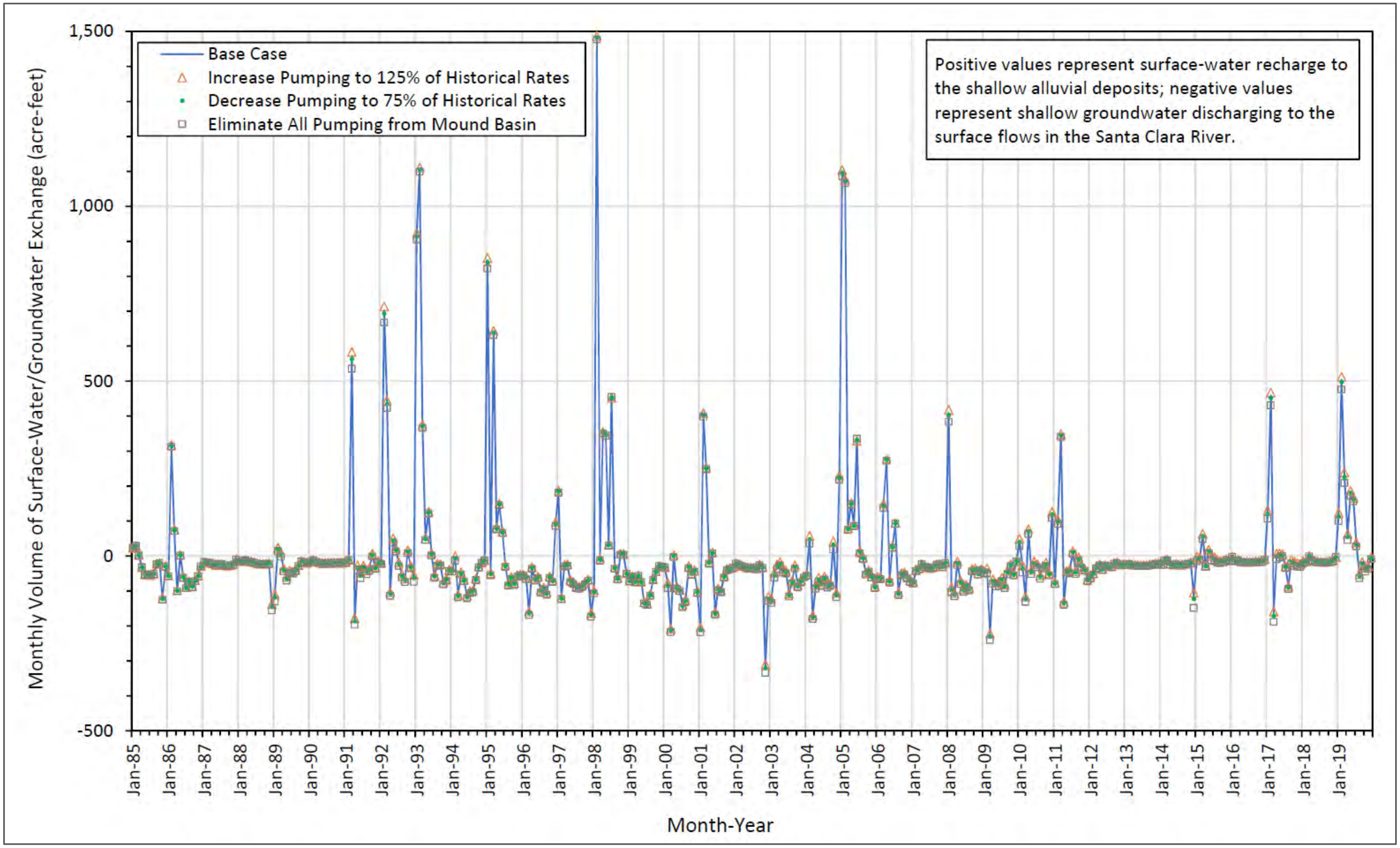
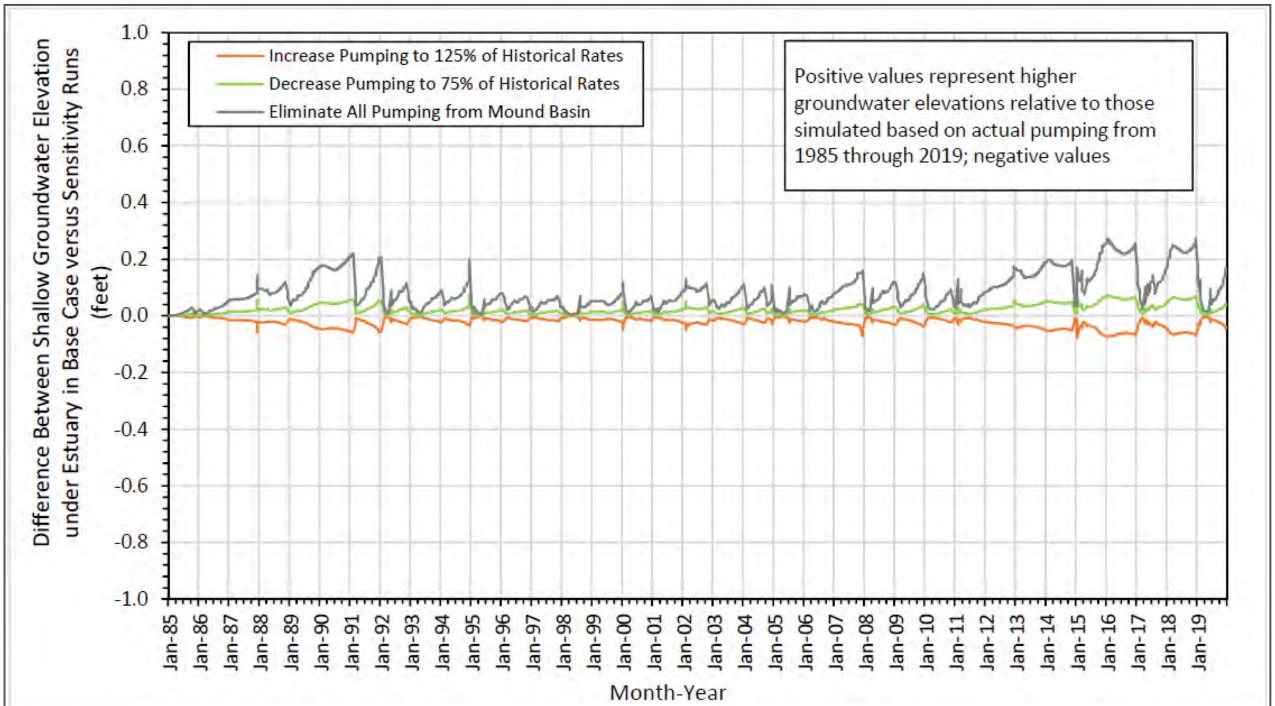


Figure G-9. Volume of Simulated Groundwater Exchange with Surface Water along Santa Clara River in Mound Basin in Base Case and Sensitivity Runs



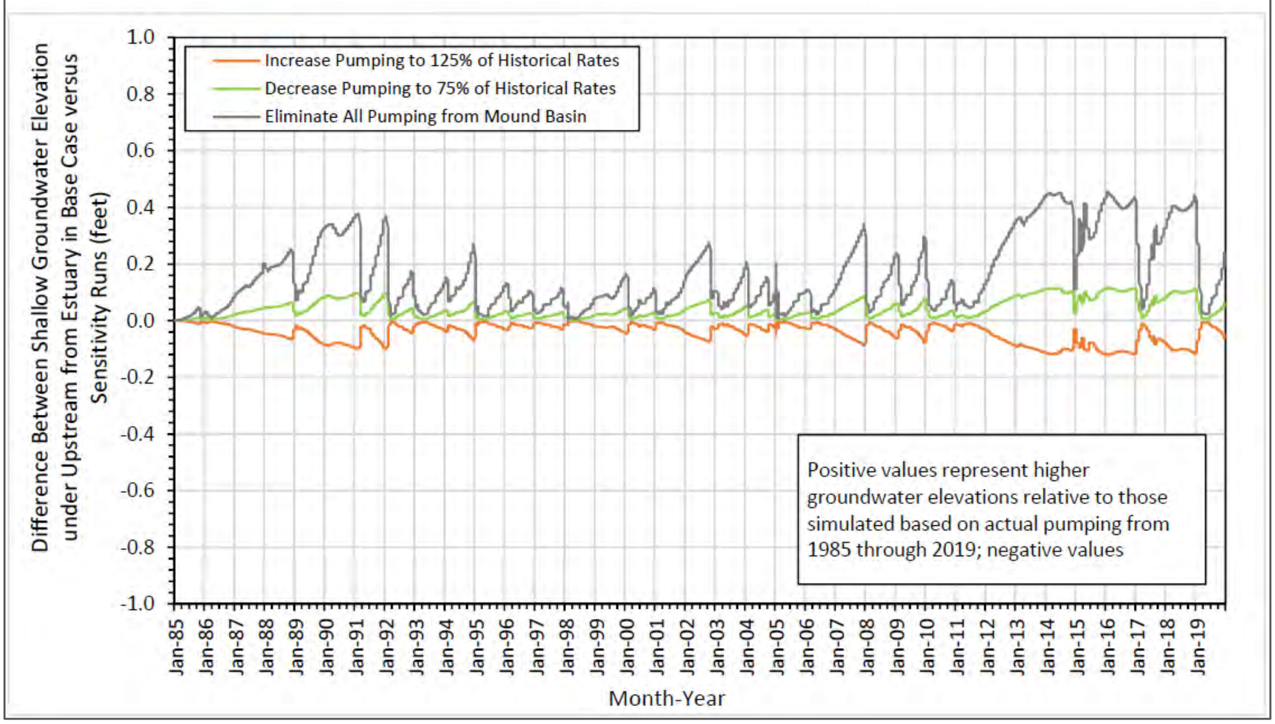


Figure G-10. Graphs Showing Differences Between Simulated Groundwater Elevations in Shallow Alluvial Deposits in Base-Case Scenario Compared to Sensitivity Runs under Santa Clara River estuary (top graph) and under Santa Clara River near Boundary between Mound and Oxnard Basins (bottom graph)

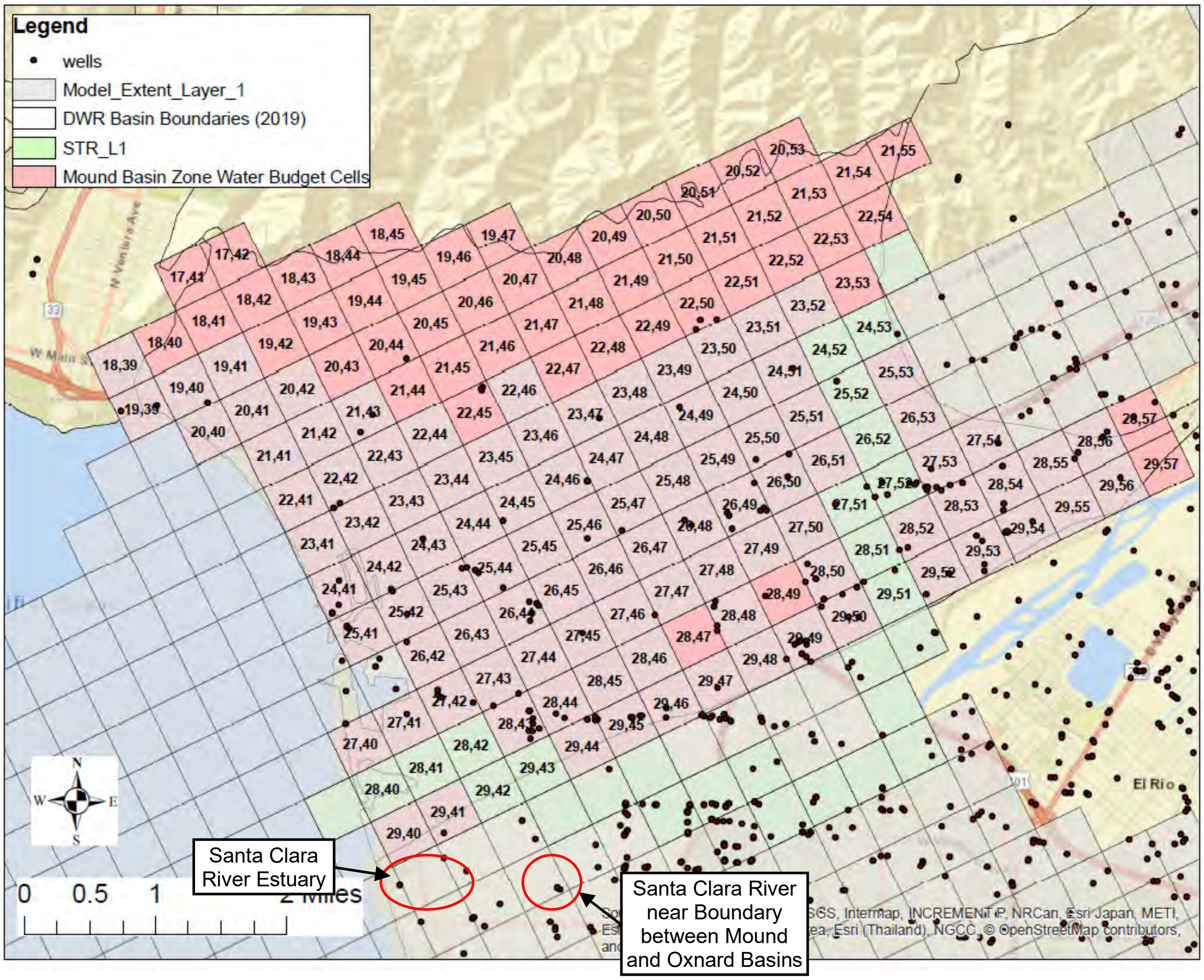


Figure G-11. Location of Model Grid Cells where Simulated Differences Between Base-Case and Sensitivity-Run Groundwater Elevations in Shallow Alluvial Deposits were Extracted for Graphing in Figure G-9

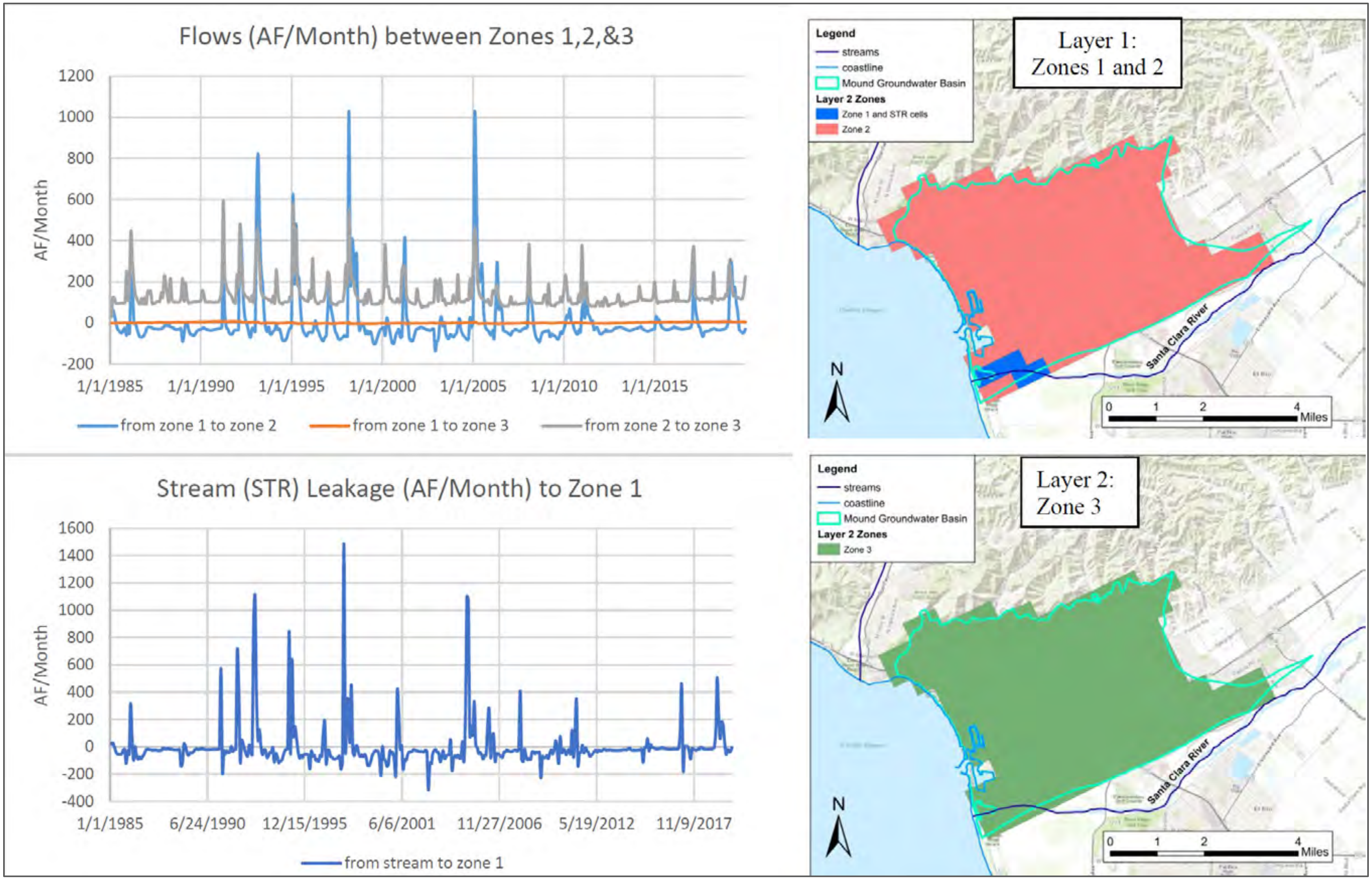


Figure G-12. Zone Budget Results for Selected Zones and the Stream Package.

Appendix H

Review of Areas Mapped as Containing Indicators of Potential Groundwater Dependent Ecosystems

Appendix H

Review of Areas Mapped as Containing Indicators of Potential Groundwater Dependent Ecosystems

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Introduction

This appendix presents the screening results for the 11 areas of mapped "indicators of groundwater dependent ecosystems" (iGDEs) within Mound Basin (Areas 1 through 11) (Figure H-1). Figures H-2 through H-12 include aerial imagery and mapping of specific "vegetation types commonly associated with the sub-surface presence of groundwater" and "wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions" (CNRA, 2020) within each of Areas 1 through 11. As noted in Mound Basin Groundwater Sustainability Plan (GSP, Section 3.2.7), mapping of iGDEs is recommended as a starting point for the identification and analysis of potential groundwater dependent ecosystems (pGDEs) under the Sustainable Groundwater Management Act (SGMA) (Klausmeyer et al., 2018). Determining whether an iGDE is actually a groundwater dependent ecosystem (GDE) requires local-scale information regarding land use, groundwater levels, surface water hydrology, and geology. That local-scale information is provided in this appendix, together with an evaluation of whether each iGDE is dependent on groundwater from a principal aquifer in Mound Basin. The following presents a summary of the iGDE screening results in addition to a detailed assessment of each of the 11 iGDE areas identified in the GSP.

Summary of iGDE Screening Results

In Areas 1-10, it was observed that plant communities are generally established in topographic areas that concentrate surface water flow, and which can retain soil moisture and/or in areas where there is irrigation. These areas include incised drainages, north-facing slopes, depressions and barrancas conveying runoff from upstream and adjacent irrigated parks and residential developments. In some cases, very shallow, perched water sustained by nearby irrigation may supply some water for transpiration; however, localized shallow perched water is not an aquifer and is therefore not managed under this GSP. MBGSA concludes that Areas 1-10 are not GDEs for the purposes of this GSP because the plant communities observed in these areas appear to be reliant on sources of water other than groundwater in an aquifer, particularly that of a principal aquifer.

To aid discussion for each iGDE area, a historic photo plate is provided for Areas 1-10 to display general historic and present conditions for each iGDE area (Attachment H-1).

Area 11 is considered a GDE because the surface water of the Santa Clara River and its estuary is interconnected with groundwater in the Shallow Alluvial Deposits and the vegetation in Area 11 is likely utilizing Shallow Alluvial Deposits groundwater for some of its transpiration needs. However, it is important to note that there is no groundwater extraction from the shallow groundwater of the Shallow Alluvial Deposits. In addition, Appendix G to the GSP explains that the Santa Clara River and its estuary and groundwater in the Shallow Alluvial Deposits are not material affected by pumping in the principal aquifers. Given the lack of potential for significant impacts to the GDEs by principal aquifer pumping, there are no potential impacts to the Area 11 GDE that need to be considered in the development of sustainable management criteria for the principal aquifers. However, MBGSA will monitor well permit applications for proposed uses of shallow groundwater in the vicinity of Area 11. If any shallow wells are proposed, MBGSA will evaluate impacts to the Area 11 GDEs. Proposed uses that would have a significant impact to Area 11 GDEs may be required to mitigate those impacts as a condition of MBGSA permit approval.

Area 1—Harmon Canyon

Area 1 is located in Harmon Canyon near the northern boundary of Mound Basin (Figure H-1), in an area underlain by “alluvial deposits and colluvial deposits” associated with “active wash deposits” of Holocene age, and landslide deposits of Holocene to Pleistocene age (Gutierrez et al., 2008). A surficial geologic map of Mound Basin is provided on Figure 3.1-02 of the GSP. These alluvial, colluvial, and landslide deposits occupy the narrow bottom and portions of the flanks of Harmon Canyon and overlie partially consolidated sedimentary deposits of the San Pedro Formation (Gutierrez et al. [2008] refer to these deposits by the nomenclature used by Dibblee [1988, 1992]; specifically, the Saugus and Las Posas Formations). The narrow, shallow “shoestring” deposits of alluvium in the foothills of northern Mound Basin are not known to store or transmit significant quantities of groundwater, nor are they currently used for groundwater supply. However, they may become partially saturated following major storms, particularly in winter and spring, potentially creating temporary perched groundwater conditions. It is unlikely that groundwater in these alluvial deposits is hydraulically connected with groundwater in the Hueneme and Fox Canyon aquifers (which are present in the underlying San Pedro Formation), as groundwater elevations in the underlying aquifers are generally hundreds of feet below ground surface in the northern Mound Basin (see Section 3.2 of the Mound Basin GSP). No seeps, springs, or perennial streams are shown on the U.S. Geological Survey (USGS) topographic maps of the Santa Paula 15-minute quadrangle or on the Saticoy 7.5-minute quadrangle in the vicinity of Area 1 (the USGS Santa Paula quadrangle map, originally published in 1903, included the area of the USGS Saticoy 7.5-minute quadrangle published in 1951 and photo-revised in 1967).

The iGDE mapped in Area 1 consists of coast live oak trees (CNRA, 2020), as shown on Figure H-2. Stands of coast live oak are also present outside of Area 1, most commonly in canyon bottoms and on north-facing slopes (Figure H-2) in areas where the substrate consists of San Pedro Formation, rather than alluvial and colluvial deposits. Photographs 1 through 4 in Attachment H-1 provide historic images from 1927 through 2021, showing continued presence of this vegetation in areas that concentrate surface water flow and which retain soil moisture. Considering the substantial depth to groundwater in the underlying principal aquifers (Hueneme and Fox Canyon aquifers), and the presence of coast live oak trees on hillsides outside of Area 1, it is unlikely that the coast live oak trees within Area 1 (or on the surrounding hillsides and canyons) are dependent on groundwater from a principal aquifer in Mound Basin. Therefore, Area 1 is not considered to be a GDE for the purpose of this GSP.

Area 2—Sexton Canyon

Area 2 is located in Sexton Canyon near the northern boundary of Mound Basin (Figure H-1), in an area underlain by “alluvial deposits and colluvial deposits” associated with “active wash deposits” of Holocene age (Gutierrez et al., 2008). No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Santa Paula quadrangle (1903 edition) or the Saticoy quadrangle (1967 edition) in the vicinity of Area 2. The iGDEs mapped in Area 2 include “wetland features commonly associated with the sub-surface presence of groundwater under natural, unmodified conditions” (and more specifically as “riverine, unknown perennial, unconsolidated bottom, semipermanently flooded” wetland) along an approximately 400-foot length of the canyon bottom, and coast live oak trees within 400 feet of area mapped as wetland (CNRA, 2020), as shown on Figure H-3. Inspection of the aerial imagery shown on Figure H-3 indicates the presence of single-family residences and irrigated landscaping within and adjacent to Area 2, and citrus or avocado orchards to the north (up-canyon), south, and east from Area 2.

Approximately 100 acres of avocado orchards and a flood-control dam are located 300 to 800 feet farther north from Area 2, outside of the area shown on Figure H-3. Similar to Area 1, stands of coast live oak are also present outside of Area 2 in Sexton Canyon, most commonly occurring in canyon bottoms and on north-facing slopes (Figure H-3) in areas where the underlying geology consists of landslide deposits or San Pedro Formation, rather than alluvial and colluvial deposits.

There is no visual evidence from the aerial photo to support the presence of the “wetland feature” mapped in Area 2. Any saturated zones present in these shallow “shoestring” alluvial deposits are unlikely to be hydraulically connected with groundwater in the Hueneme and Fox Canyon aquifers present in the underlying San Pedro Formation, as groundwater elevations in these aquifers are generally hundreds of feet below ground surface in the northern Mound Basin. Any perched saturated zones within the alluvial and colluvial deposits are almost certainly not in hydraulic connection with the underlying principal aquifers (Hueneme and Fox Canyon aquifers), and coast live oak trees are present on hillsides outside of Area 2 where they do not have access to perched groundwater. Photographs 5 and 6 in Attachment H-1 provide historic images from 1958 and 2021, showing continued presence of this vegetation in areas that concentrate surface water flow and which retain soil moisture.

Based on this analysis, the iGDEs in Area 2 are not believed to be dependent on groundwater from a principal aquifer in Mound Basin, and Area 2 is not considered to be a GDE for the purpose of this GSP.

Area 3—Barlow Canyon (Arroyo Verde Park)

Area 3 is located in Barlow Canyon along the western margin of the irrigated fields in the south part of Arroyo Verde Park, in the foothills of northern Mound Basin (Figure H-1). Similar to Areas 1 and 2, Area 3 is underlain by shallow “alluvial deposits and colluvial deposits” associated with “active wash deposits” of Holocene age (Gutierrez et al., 2008). No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Santa Paula quadrangle (1903 edition) or the Saticoy quadrangle (1967 edition) in the vicinity of Area 3. The iGDE mapped in Area 3 consists of “riparian mixed hardwood” (CNRA, 2020), as shown on Figure H-4. Inspection of the aerial imagery shown on Figure H-4 indicates the presence of approximately 25 acres of irrigated turf, baseball fields, and picnic areas in Arroyo Verde Park immediately adjacent to and up-canyon from Area 3. Field visits confirm this area is irrigated by the City of Ventura.

The iGDE mapped at Area 3 is located approximately 30 feet above Barlow Canyon and is likely dependent on irrigation, rather than groundwater. Groundwater in the Hueneme and Fox Canyon aquifers present in the underlying San Pedro Formation is generally hundreds of feet below ground surface in the northern Mound Basin. Photographs 7 through 10 in Attachment H-1 provide historic images from 1927 through 2021, showing changing land uses from open space to agriculture up to the current parks/recreation. Between photos 9 and 10 we see the establishment of the vegetation community, understood to demonstrate the effect that irrigation has in this area. Because the iGDE present in Area 3 is likely to be dependent on irrigation, as well as the separation from principal aquifers, this iGDE is not believed to be dependent on groundwater from a principal aquifer in Mound Basin. Therefore, it is not considered to be a GDE for the purpose of this GSP.

Area 4—Sanjon Barranca

Area 4 is located in the canyon bottom and east-facing slope of Sanjon Barranca in the foothills north of downtown Ventura near the northern boundary of Mound Basin (Figure H-1). Area 4 is underlain by the "Saugus Formation" (referred to as San Pedro Formation in the GSP) and "alluvial deposits and colluvial deposits" associated with "active wash deposits" of Holocene age in the canyon bottom (Gutierrez et al., 2008). No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Ventura quadrangle (1904 or 1951 editions) in the vicinity of Area 4. The iGDE mapped in Area 4 is coast live oak (CNRA, 2020), as shown on Figure H-5. The aerial imagery shown on Figure H-5 was obtained after the Thomas Fire burned the foothills north of Ventura in December 2017, which is why only grass and some small shrubs are apparent on Figure H-5. Review of older aerial imagery available in Google Earth in the vicinity of Area 4 indicates that trees and shrubs were more abundant prior to the Thomas Fire. Similar stands of trees and shrubs were also present outside of the mapped iGDE area in Sanjon Barranca and nearby drainages, most commonly in canyon bottoms and on north-facing slopes (some can be seen on Figure H-5) in areas where the underlying geology consists of landslide deposits or San Pedro Formation. Photographs 11 through 14 in Attachment H-1 provide historic images from 1927 through 2021, showing the vegetation community in areas that concentrate surface water flow and which retain soil moisture (as well as the Thomas Fire impacts in photo 14).

Considering the absence of mapped springs or seeps, the substantial depth to groundwater in the underlying principal aquifers (Hueneme and Fox Canyon aquifers), and the nature of the coast live oak community to occur in upland areas without access to groundwater, it is unlikely that the coast live oaks within Area 4 (or on the surrounding hillsides and canyons) are dependent on groundwater from a principal aquifer in Mound Basin. Therefore, the iGDE in Area 4 is not considered to be a GDE for the purpose of this GSP.

Area 5—Kennebec Linear Park and North Bank of Santa Clara River near Saticoy

Area 5 includes two iGDEs: one iGDE is in an unnamed barranca within Kennebec Linear Park, and the other is mapped along the north bank of the Santa Clara River near Kennebec Linear Park. Area 5 is underlain by stream terrace deposits "of latest Holocene age" and "active wash deposits within major river channels" of Holocene age (Gutierrez et al., 2008). No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Santa Paula quadrangle (1903 edition) or the Saticoy quadrangle (1967 edition) in the vicinity of Area 5 within Mound Basin.

The iGDEs in Area 5 include mixed willow forest along the north bank of the Santa Clara River, and mixed riparian forest in the unnamed barranca within Kennebec Linear Park (CNRA, 2020), as shown on Figure H-6. Inspection of the aerial imagery shown on Figure H-6 indicates the presence of irrigated turf landscaping on the northeast and southwest flanks of Kennebec Linear Park where the "mixed riparian forest" is mapped, and in residential subdivisions of single-family residences present adjacent to both iGDEs in Area 5. In addition, a storm drain outlet is located at the northern boundary of the iGDE in the barranca, discharging storm water, irrigation runoff, and other non-storm water flows from the upper watershed drainage area.

Small quantities of perched groundwater likely are present at shallow depths in the stream terrace deposits underlying Area 5 as a result of park and residential irrigation in the area. However, the primary source water supporting the iGDEs appears to be landscape irrigation at Kennebec Linear Park and surface water in the unnamed barranca (surface water from urban runoff via storm water drains and precipitation events). Photographs 15 through 18 in Attachment H-1 provide historic images from 1945 through 2021, showing the vegetation communities in these iGDEs. These photos illustrate the land use changes over time, presence of the unnamed barranca, and establishment of the vegetation communities in the barranca and on the slopes below the southern edge of the linear park.

Because the iGDEs present in Area 5 appear to be primarily dependent on upstream surface water sources, irrigation, and return flows occurring in shallow perched zones for their water supply, Area 5 is not considered to be a GDE for the purpose of this GSP.

Area 6—Harmon Barranca and Park

Area 6 occupies an approximately 1,200-foot-long reach of Harmon Barranca near the southern boundary of Harmon Park (Figure H-1). Area 6 is underlain by a narrow band of "active wash deposits within major river channels" of Holocene age and alluvial fan deposits of "latest Holocene" age (Gutierrez et al., 2008). No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Santa Paula quadrangle (1903 edition) or the Saticoy quadrangle (1967 edition) in the vicinity of Area 6.

The iGDE in Area 6 is riparian mixed hardwood (CNRA, 2020), as shown on Figure H-7. Inspection of the aerial imagery shown on Figure H-7 indicates the presence of subdivisions of single-family residences both east and west adjacent to Area 6; not visible on Figure H-7 is Barranca Vista Park, which includes 3 acres of irrigated turf, approximately 1,000 feet north of Area 6 adjacent to Harmon Barranca. Irrigation return flows from Barranca Vista Park and from the residential neighborhoods adjacent to Harmon Barranca would be expected to percolate to thin, shallow perched zones in near-surface soils and then migrate horizontally to Harmon Barranca (the nearest topographic "low"), where the perched water can seep out to land surface in the bed and banks of the barranca.

In addition, surface water in the barranca is another source of water for the iGDE (surface water from urban runoff via storm water drains and precipitation events). The return flows and surface water are believed to be primary sources of water for the iGDE mapped at Area 6. Photographs 19 through 22 in Attachment H-1 provide historic images from 1945 through 2021, showing the changes in agricultural irrigation and land use over time. While the vegetation in the barranca is present in 1927, the density generally increases over time in response to the changing land use. Based on the understanding that shallow perched groundwater conditions likely occur and the separation from the principal aquifers, as well as the presence of stormwater, irrigation runoff, and other non-storm water flows, Area 6 is not considered to be a GDE for the purpose of this GSP.

Area 7—Arundell Barranca (northern)

Area 7 occupies an approximately 1,500-foot-long reach of Arundell Barranca near the mouth of Sexton Canyon in the northeast portion of Mound Basin (Figure H-1). The iGDE in Area 7 consists of "wetland features commonly associated with the sub-surface presence of groundwater under natural, unmodified conditions" (and more specifically as "riverine, unknown perennial, unconsolidated bottom, semipermanently flooded”), according to the CNRA (2020), as shown on Figure H-8. Area 7 is underlain by “active wash deposits within major river channels” of Holocene age (Gutierrez et al., 2008). No seeps or springs are shown on the USGS topographic map of the Santa Paula quadrangle (1903 edition) or the Saticoy quadrangle (1967 edition) in the vicinity of Area 7.

Arundell Barranca conveys surface water from a relatively large drainage area and is supplied by upstream surface water sources. Surface-water flow is shown on the 1967 edition of the USGS Saticoy quadrangle map as perennial within and downstream from Area 7; however, surface flow in Arundell Barranca is not shown as perennial on the 1903 edition of the Santa Paula quadrangle map. The channel is lined just upstream of the mapped iGDE and water is visible in the lined portion of the channel, but the unlined portion appears dry (Figure H-8). The source of water is likely urban runoff and storm water routed to the barranca via storm drains.

Inspection of the aerial imagery shown on Figure H-8 indicates the presence of subdivisions of single-family residences both east and west adjacent to Area 7. Farther upstream (in Sexton Canyon north of Foothill Road, beyond the field of view of Figure H-8) are approximately 150 acres of avocado orchards and additional residential development. Irrigation return flows from the adjacent and upstream residential neighborhoods, as well as the upstream orchards, would be expected to percolate to thin, shallow perched zones in near-surface soils and the active wash deposits, then migrate horizontally to Arundell Barranca (the nearest topographic “low” where surface water and shallow groundwater drainage can collect), and then seep out to the bed and banks of the barranca. These return flows likely are a source of water for the iGDE mapped at Area 7. Photographs 23 through 26 in Attachment H-1 provide historic images from 1938 through 2021. In addition to documenting the changes in land use over time, these photos show the presence of vegetation in the barranca over time.

Based on the understanding that shallow perched groundwater conditions likely occur and the separation from the principal aquifers, as well as the presence of surface water flows and irrigation return flows, Area 7 is not considered to be a GDE for the purpose of this GSP.

Area 8—Arundell Barranca (central)

Area 8 occupies an approximately 1,300-foot-long reach of Arundell Barranca near the center of Mound Basin at the U.S. Highway 101 and State Highway 126 interchange (Figure H-1). As shown on Figure H-9, most of this reach of Arundell Barranca presently is in a closed culvert (a concrete-lined tunnel) beneath Highways 101 and 126 and their on- and off-ramps. Surface-water flow in Arundell Barranca is shown on the 1967 edition of the USGS Saticoy quadrangle map as perennial upstream and downstream of Area 8; however, surface flow in Arundell Barranca is not shown as perennial on the 1903 edition of the Santa Paula quadrangle map. The iGDE in Area 8 consists of “wetland features commonly associated with the sub-surface presence of groundwater under natural, unmodified conditions” (and more specifically as “riverine, unknown perennial, unconsolidated bottom, semipermanently flooded”), according to the CNRA (2020), as shown on Figure H-9. The source of water is likely urban runoff and storm water routed to the barranca via storm drains.

Inspection of the aerial imagery shown on Figure H-9 indicates the presence of a subdivision of single-family residences northwest adjacent to Area 8, and Camino Real Park to the northeast. Upstream of Area 8, most of Arundell Barranca within Mound Basin is flanked by residential subdivisions or orchards (in the foothills in the northern part of Mound Basin). Irrigation return flows from the adjacent and upstream residential neighborhoods, as well as the upstream orchards, would be expected to percolate to thin, shallow perched zones in near-surface soils and the active wash deposits, then migrate horizontally to Arundell Barranca (the nearest topographic "low"), where they can seep out to land surface in the bed and banks of the barranca. These return flows likely are the primary sources of water for the iGDE mapped upstream from State Highway 126 at Area 8. The remainder of Area 8 is located in a closed culvert under State Highway 126 and U.S. Highway 101—the iGDE depicted in the CNRA (2020) database in this reach of Arundell Barranca seems to be in error.

Similar to Area 7, any saturated zones present in the thin active wash deposits present in Area 8 north of State Highway 126 are unlikely to be hydraulically connected with groundwater in the underlying principal aquifers of Mound Basin. Photographs 27 and 28 in Attachment H-1 provide historic images from 1958 and 2021. As is the case with Area 7, these photos document the changes in land use over time (specifically the development of State Highway 126) and show the presence of vegetation in the barranca over time. Because the iGDE present in Area 8 north of State Highway 126 is believed to be primarily dependent on surface water and irrigation return flows for its water supply, and because the area south of State Highway 126 is a culvert, Area 8 is not considered to be a GDE for the purpose of this GSP.

Area 9—Prince Barranca

Area 9 occupies an approximately 5,000-foot-long reach of Prince Barranca from near the mouth of Hall Canyon to Main Street, Ventura, in the northwest portion of Mound Basin (Figure H-1). Area 9 is underlain by "alluvial deposits and colluvial deposits" associated with "active wash deposits" of Holocene age (Gutierrez et al., 2008). No seeps or springs are shown on the USGS topographic maps of the Ventura 15- and 7.5-minute quadrangles (1904 and 1951 editions, respectively) in the vicinity of Area 9. Surface-water flow in Prince Barranca is shown on the 1951 edition of the USGS Ventura quadrangle map as perennial within and upstream of Area 9; however, surface flow in Prince Barranca is not shown as perennial on the 1904 edition.

The iGDE in Area 9 consists of "wetland features commonly associated with the sub-surface presence of groundwater under natural, unmodified conditions" (and more specifically as "palustrine [marsh], scrub-shrub, seasonally flooded"), according to the CNRA (2020), as shown on Figure H-10. Inspection of the aerial imagery shown on Figure H-10 indicates the presence of subdivisions of single-family residences both east and west adjacent to most of Area 9, except in the lower reaches of Hall Canyon where it lies adjacent to irrigated baseball fields. Within Hall Canyon, an approximately 14-acre avocado orchard is present adjacent to the east margin of the iGDE mapped in Area 9. Irrigation return flows from the adjacent residential neighborhoods and orchard would be expected to percolate to thin, shallow perched zones in near-surface soils deposits, then migrate horizontally to Prince Barranca (the nearest topographic "low"), and then seep out of the bed and banks of the barranca. These return flows likely are the primary sources of water for the iGDE mapped at Area 9 outside of precipitation-induced runoff events. Any saturated zones present in the thin active wash deposits present in Area 9 are unlikely to be hydraulically connected with groundwater in the underlying principal aquifers of Mound Basin.

Because the iGDEs present in Area 9 are believed to be primarily dependent on precipitation runoff and irrigation return flows for their water supply, and any perched saturated zones within the shallow alluvial deposits in Area 9 are not likely to be hydraulically connected with the underlying principal aquifers, Area 9 is not considered to be a GDE for the purpose of this GSP.

Area 10—Alessandro Lagoon

Area 10 consists of the Alessandro Lagoon, which occupies approximately 6 acres between U.S. Highway 101 and Alessandro Drive in the west part of Mound Basin (Figure H-1). Area 10 is underlain by "paralic deposits (interfingered marine and non-marine sediments) of the Sea Cliff marine terrace" of Holocene age (Gutierrez et al., 2008). The iGDE in Area 10 consists of "willow shrub" (CNRA, 2020), as shown on Figure H-11. No seeps, springs, or perennial streams are shown on the USGS topographic maps of the Ventura 15- and 7.5-minute quadrangles (1904 and 1951 editions, respectively) in the immediate vicinity of Area 10, although the USGS topographic map edition of 1951 shows marshland present approximately ¼-mile southeast of Area 10. This marshland has subsequently been filled and is now the site of residential and commercial development.

A map of historical estuarine and related habitats for the Ventura area prepared by Grossinger et al. (2011) indicates that both Area 10 and the marshland to the south were occupied by sand dunes in the late 19th century, with no wetland vegetation depicted. In December 1982, the City of Ventura designated Alessandro Lagoon a point of interest due to its history and its value as a freshwater refuge on the Pacific Coast flyway within Ventura County (City of Ventura, 2020). During the late 19th and early 20th centuries, the area was known as "Chautaqua Flats" and was the site of camping and amusement enterprises (City of Ventura, 2020). Neither the map presented by Grossinger et al. (2011) nor the 1951 USGS topographic maps of the Ventura quadrangle indicate the presence of features suggesting water at land surface within Area 10 from the late 19th century through 1951. Thus, it appears that the lagoon formed sometime after 1951. This is consistent with the fact that the lagoon occupies a fully enclosed depression between U.S. Highway 101 on the south and bluffs to the north. It appears that construction of U.S. Highway 101 served to create the southern enclosure of the depression that is now occupied by the lagoon. U.S. Highway 101 was constructed along the southern margin of the lagoon in 1959 and 1960.

Photographs 33 through 36 in Attachment H-1 provide historic images from 1959 through 2021, and document the changes described above. Because this iGDE appears to be dependent on surface water that becomes trapped within a closed artificial depression, Area 10 is not considered to be a GDE for the purpose of this GSP.

Area 11—Lower Santa Clara River and Estuary

Area 11 occupies much of the channel of the lower Santa Clara River within Mound Basin, the river's estuary, and adjacent lowlands (Figure H-1). A map of historical estuarine and related habitats for the Ventura area prepared by Grossinger et al. (2011) shows that "open water," "vegetated wetland," and "vegetated woody" areas existed in Mound Basin within and adjacent to the lower Santa Clara River in the late 19th century. As described by Stillwater Sciences (2011), "The lower Santa Clara River and Santa Clara River estuary (SCRE) have undergone considerable geomorphic change over the past 150 years since European-American settlement due to a combination of land-use practices and climatic conditions. Historically, the SCRE was an expansive ecosystem that included an open-water lagoon and a series of channels that supported intertidal vegetation. Land development since the mid-19th century has resulted in a 75% to 90% decrease in overall SCRE area and available habitat, and the confinement of flood flows by levees." Area 11 is underlain by "active wash deposits within major river channels" of Holocene age, stream terrace deposits, alluvial and colluvial deposits, and artificial fill (Gutierrez et al., 2008).

The iGDEs within Area 11 consist of seven "vegetation types commonly associated with the sub-surface presence of groundwater," and "wetland features commonly associated with the sub-surface presence of groundwater under natural, unmodified conditions," according to the CNRA (2020), as shown on Figure H-12. No seeps, springs, or perennial streams are shown on the USGS 1904 topographic map of the Hueneme 15-minute quadrangle or the USGS 1949 topographic map of the Oxnard 7.5-minute quadrangle (photo revised in 1967). Both the 1904 and the 1949 topographic maps show estuary lakes of 50 to 70 acres in area at the mouth of the Santa Clara River, separated from the Pacific Ocean by a narrow beach area. The 1949 Oxnard quadrangle map also shows a small pond in the Santa Clara River floodplain approximately 1.25 miles upstream from the coastline.

Sources of Water to Area 11

At present, the Olivas Links golf course and Ventura's wastewater treatment plant (WWTP), which includes artificial treatment ponds shaped to fit in the natural landscape, are present adjacent to (and partly within) Area 11 to the north (Figure H-12). Farm fields and the campground at McGrath State Beach are adjacent to Area 11 to the south (Figure H-12). Sources of water and their relative contributions to surface flows within the lower Santa Clara River and its estuary were estimated by Stillwater Sciences (2011) for the period from October 25, 2009, through September 15, 2010, as follows:

- Surface flows in the Santa Clara River originating upstream from Mound Basin—80% of the total inflow.
- Effluent discharge from Ventura's WWTP—8% of total inflow.
- Surface inflows from the Pacific Ocean during high tides—7% of total inflow.
- Groundwater inflow from the Shallow Alluvial Deposits in Mound Basin and from the semi-perched Aquifer in Oxnard Basin—4% (combined) of total inflow.
- Direct precipitation—less than 1% of total inflow.
- Subsurface tidal inflow—less than 1% of total inflow.

Although not included in Stillwater Sciences (2011) accounting of inflows, tile drains underlying farm fields and overland surface runoff produced during storm events likely also contribute water to the lower Santa Clara River (United, 2018). It should be noted that much of the groundwater present in the Shallow Alluvial Deposits in Mound Basin and the semi-perched aquifer of the Oxnard Basin near Area 11 consists of return flows from irrigation water applied to the golf courses and farm fields north and south of the Santa Clara River (United, 2018).

Although surface flows originating upstream from Mound Basin dominate the inflow of water to the lower Santa Clara River (and Area 11), those flows are ephemeral, only reaching the lower Santa Clara River in Mound Basin following major storms, which occur primarily in winter and spring (Stillwater Sciences, 2011). Therefore, the primary sources of water supporting Area 11 iGDEs during dry months and drought periods include tile-drain discharges, effluent from Ventura's WWTP, and groundwater discharge from the semi-perched aquifer in Oxnard Basin.

Following TNC guidance, each of the iGDEs within Area 11 were analyzed and slightly revised to more accurately reflect the vegetation communities present. These potential GDEs were then grouped into the Area 11 GDE Unit. The Area 11 GDE Unit was characterized and evaluated based on the vegetation communities present and the potential to provide habitat for special status plant and wildlife species.

Characterization of the Area 11 GDE Unit

Vegetation Communities

The following iGDEs are mapped within the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset within Area 11 (Figure H-12):

- *Leymus triticoides*
- Mixed willow forest
- *Populus balsamifera – Salix lasiolepis*
- *Salix lasiolepis*
- *Salix lucida*
- *Scirpus* spp.
- Wetlands

These vegetation communities were reviewed by biologists at Rincon Consultants Inc. (Rincon) and compared with previous vegetation mapping that was completed within the SCRE by Stillwater Sciences (2011) and WRA (2014). Based on this analysis, the following vegetation communities with potential to be groundwater dependent were mapped within Area 11 (Figure H-13):

- Arroyo Willow Thicket
- Black Cottonwood Forest
- Freshwater Marsh
- *Arundo* stands
- Wetlands

Stands of *Arundo donax* (giant reed) are widespread throughout Area 11 (Stillwater Sciences, 2011). Arundo is a highly invasive species that utilizes up to six times more water than native riparian plant species (Giessow et al., 2011). Other invasive plant species that are prevalent within Area 11 include salt cedar (*Tamarisk* spp.) and iceplant (*Carpobrotus* spp.). These invasive plant species can provide habitat for wildlife but have an overall detrimental impact on the ecosystems within which they occur due to their rapid growth rates and ability to out-compete native species for resources (i.e., water and nutrients).

Critical Habitat

Rincon queried the U.S. Fish and Wildlife Service (USFWS) Critical Habitat Portal (USFWS 2021) and the NOAA Critical Habitat maps (NOAA, 2021) for information on federally designated critical habitat within Area 11 (Figure H-14). The area includes critical habitat for four federally listed species: Southern California distinct population segment (DPS) steelhead (*Oncorhynchus mykiss irideus*), tidewater goby (*Eucyclogobius newberryi*), southwestern willow flycatcher (*Empidonax traillii extimus*), and western snowy plover (*Charadrius nivosus nivosus*). Critical habitat for Ventura Marsh milk vetch (*Astragalus pycnostachyus var. lanosissimus*) lies approximately 0.7 miles south of the Mound Basin boundary.

Special Status Species

For the purposes of this document, special status species are defined as those:

- Listed, proposed, or candidates for listing as endangered or threatened under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA).
- Designated by the CDFW as a Species of Special Concern (SSC) or Watchlist Species (WL).
- Designated by the CDFW as Fully Protected (FP) under the California Fish and Game Code (Sections 3511, 4700, 5050, and 5515).
- Included on CDFW's most recent Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2021c) with a California Rare Plant Rank (CRPR) of 1 or 2.
- Protected by the Migratory Bird Treaty Act (MBTA) or California Fish and Game Code Section 3503.

Special Status Plant Species

Rincon queried the California Natural Diversity Database (CNDDB; CDFW, 2021a), the California Native Plant Society (CNPS, 2021) Inventory of Rare Plants, and Calflora (Calflora, 2021) for occurrences of special status plant species within the Ventura, Oxnard, and Saticoy 7.5-minute USGS quadrangles. Based on these queries, 14 plant species were evaluated for their potential to occur within Mound Basin and Area 11 (Attachment H-2). Of these, eight special status plant species have some potential to occur within Area 11. Table H-1 provides a summary of these species, their regulatory status, their potential to occur, and their potential GDE Association.

Table H-1 Special Status Plant Species with Potential to Occur within Area 11

Scientific Name **Common Name**	**Status** **Fed/State ESA** **CDFW**	**Potential to Occur[1]**	**GDE Association[1]**
Aphanisma blitoides aphanisma	None/None G3G4/S2 1B.2	Likely to Occur	Unlikely
Astragalus pycnostachyus var. *lanosissimus* Ventura Marsh milk-vetch	FE/SE 1B.1	Present	Likely
Atriplex coulteri Coulter's saltbush	None/None G3/S1S2 1B.2	May Occur	Unlikely
Atriplex pacifica south coast saltscale	None/None G4/S2 1B.2	May Occur	Unlikely
Chaenactis glabriuscula var. *orcuttiana* Orcutt's pincushion	None/None G5T1T2/S1 1B.1	Likely to Occur	Unlikely

Scientific Name Common Name	Status Fed/State ESA CDFW	Potential to Occur[1]	GDE Association[1]
Chloropyron maritimum ssp. *maritimum* salt marsh bird's-beak	FE/SE G4?T1/S1 1B.2	May Occur	Likely
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	None/None G4T2/S2 1B.1	May Occur	Likely
Pseudognaphalium leucocephalum white rabbit-tobacco	None/None G4/S2 2B.2	May Occur	Unlikely

[1] Attachment H-2 presents criteria for assessing species' potential to occur and GDE association.

CRPR (California Rare Plant Rank)

1A=Presumed Extinct in California.

1B=Rare, Threatened, or Endangered in California and elsewhere.

2A=Plants presumed extirpated in California, but more common elsewhere.

2B=Plants Rare, Threatened, or Endangered in California, but more common elsewhere.

CRPR Threat Code Extension

.1=Seriously endangered in California (over 80% of occurrences threatened/high degree and immediacy of threat).

.2=Fairly endangered in California (20-80% occurrences threatened).

.3=Not very endangered in California (<20% of occurrences threatened).

CDFW Rare

G1 or S1 = Critically Imperiled Globally or Subnationally (state).

G2 or S2 = Imperiled Globally or Subnationally (state).

G3 or S3 = Vulnerable to extirpation or extinction Globally or Subnationally (state).

G4/5 or S4/5 = Apparently secure, common and abundant.

GNR/SNR= Globally or Subnationally (state) not ranked.

Special Status Wildlife Species

Rincon queried the CNDDB, eBird (Cornell Lab of Ornithology, 2021a), and other literature sources (e.g., Stillwater Sciences 2011; WRA, 2014; Labinger et al., 2011) for occurrences of special status wildlife species within the Ventura, Oxnard, and Saticoy 7.5-minute USGS quadrangles. Based on these queries, thirty-six species were evaluated for their potential to occur within Mound Basin and Area 11 (Attachment H-2). Of these, eight special status plant species have some potential to occur within Area 11. Table H-1 provides a summary of these species, their regulatory status, their potential to occur, and their potential GDE Association.

Table H-2 Special Status Wildlife Species with Potential to Occur within Area 11

Scientific Name Common Name	Status Fed/State ESA CDFW	Potential to Occur[1]	GDE Association[1]
Invertebrates			
Danaus plexippus pop. 1 monarch - California overwintering population	FC/None G4T2T3/S2S3	May Occur (non-roosting)	Indirect
Fish			
Catostomus santaanae Santa Ana sucker	FT/None G1/S1	May Occur	Direct

Scientific Name Common Name	Status Fed/State ESA CDFW	Potential to Occur[1]	GDE Association[1]
Eucyclogobius newberryi tidewater goby	FE/None G3/S3	Present	Direct
Entosphenus tridentatus Pacific lamprey	None/None SSC	Present	Direct
Gila orcuttii arroyo chub	None/None SSC (Non-Native to Santa Clara River)	May Occur	Direct
Oncorhynchus mykiss irideus pop. 10 Southern California DPS steelhead	FE/None	Present	Direct
Amphibians			
Rana draytonii California red-legged frog	FT/None SSC	May Occur	Direct
Reptiles			
Anniella ssp. California legless lizard	None/None G3G4/S3S4 SSC	Likely to Occur	Indirect
Anniella stebbinsi Southern California legless lizard	None/None G3/S3 SSC	Likely to Occur	Indirect
Aspidoscelis tigris stejnegeri coastal whiptail	None/None G5T5/S3 SSC	May Occur	No known dependence on groundwater
Actinemys pallida (Emys marmorata) Southwestern pond turtle	None/None SSC	May Occur	Direct
Phrynosoma blainvillii coast horned lizard	None/None G3G4/S3S4 SSC	May Occur	No known dependence on groundwater
Thamnophis hammondii Two-striped gartersnake	None/None SSC	Likely to Occur	Direct
Birds			
Agelaius tricolor tricolored blackbird	None/ST G1G2/S1S2 SSC	Present	Indirect
Athene cunicularia burrowing owl	None/None G4/S3 SSC	Present	No known dependence on groundwater
Charadrius nivosus western snowy plover	FT/None G3T3/S2 SSC	Present	Indirect
Circus hudsonius northern harrier	None/None G5/S3 SSC	Present	Indirect
Coccyzus americanus occidentalis western yellow-billed cuckoo	FT/SE G5T2T3/S1	May Occur	Indirect

Scientific Name Common Name	Status Fed/State ESA CDFW	Potential to Occur[1]	GDE Association[1]
Elanus leucurus white-tailed kite	None/None G5/S3S4 FP	Present	Indirect
Empidonax traillii extimus Southwestern willow flycatcher	FE/SE	May Occur	Indirect
Falco peregrinus anatum American peregrine falcon	None/ST G3G4T1/S1 FP	Present (foraging)	Indirect
Passerculus sandwichensis beldingi Belding's savannah sparrow	None/SE G5T3/S3	Present	Indirect
Polioptila californica coastal California gnatcatcher	FT/None G4G5T3Q/S2 SSC	Unlikely to Occur	Indirect
Riparia bank swallow	None/ST G5/S2	Present	Indirect
Setophaga petechia Yellow warbler	None/None SSC	Present	Indirect
Sternula antillarum browni California least tern	FE/SE G4T2T3Q/S2 FP	Present	Indirect
Vireo bellii pusillus Least Bell's vireo	FE/SE G5T2/S2	Present	Indirect
Mammals			
Antrozous pallidus pallid bat	None/None G4/S3 SSC	Unlikely to Occur	No known dependence on groundwater

[1] Attachment H-2 presents criteria for assessing species' potential to occur and GDE association.

Fed = Federal	SSC= CDFW Species of Special Concern
ESA = Endangered Species Act	SE = State Endangered
CDFW = California Department of Fish and Wildlife	ST = State Threatened
FE = Federally Endangered	SCE = State Candidate Endangered
FT = Federally Threatened	FP = State Fully Protected

Ecological Value

The Area 11 GDE Unit includes the lower Santa Clara River and the SCRE and has a high ecological value. This area includes federally designated critical habitat for southern California DPS steelhead, southwestern willow flycatcher, tidewater goby, and western snowy plover. The estuary also provides known or potential habitat for eight special status plant species and 28 special status wildlife species (Tables H-1 and H-2), in addition to providing habitat for numerous other species. The SCRE is a highly productive ecosystem that provides important foraging, breeding, rearing, and migration habitat for shore birds, fishes, and other wildlife species.

Consideration of Area 11 GDE in the GSP

It is important to note that there is no groundwater extraction from the shallow groundwater of the Shallow Alluvial Deposits. In addition, Appendix G to the GSP explains that the Santa Clara River and its estuary and groundwater in the Shallow Alluvial Deposits are not material affected by pumping in the principal aquifers. Given the lack of potential for significant impacts to the GDEs by principal aquifer pumping, there are no potential impacts to the Area 11 GDE that need to be considered in the development of sustainable management criteria for the principal aquifers. However, MBGSA will monitor well permit applications for proposed uses of shallow groundwater in the vicinity of Area 11. If any shallow wells are proposed, MBGSA will evaluate impacts to the Area 11 GDEs. Proposed uses that would have a significant impact to Area 11 GDEs may be required to mitigate those impacts as a condition of MBGSA permit approval.

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Figures

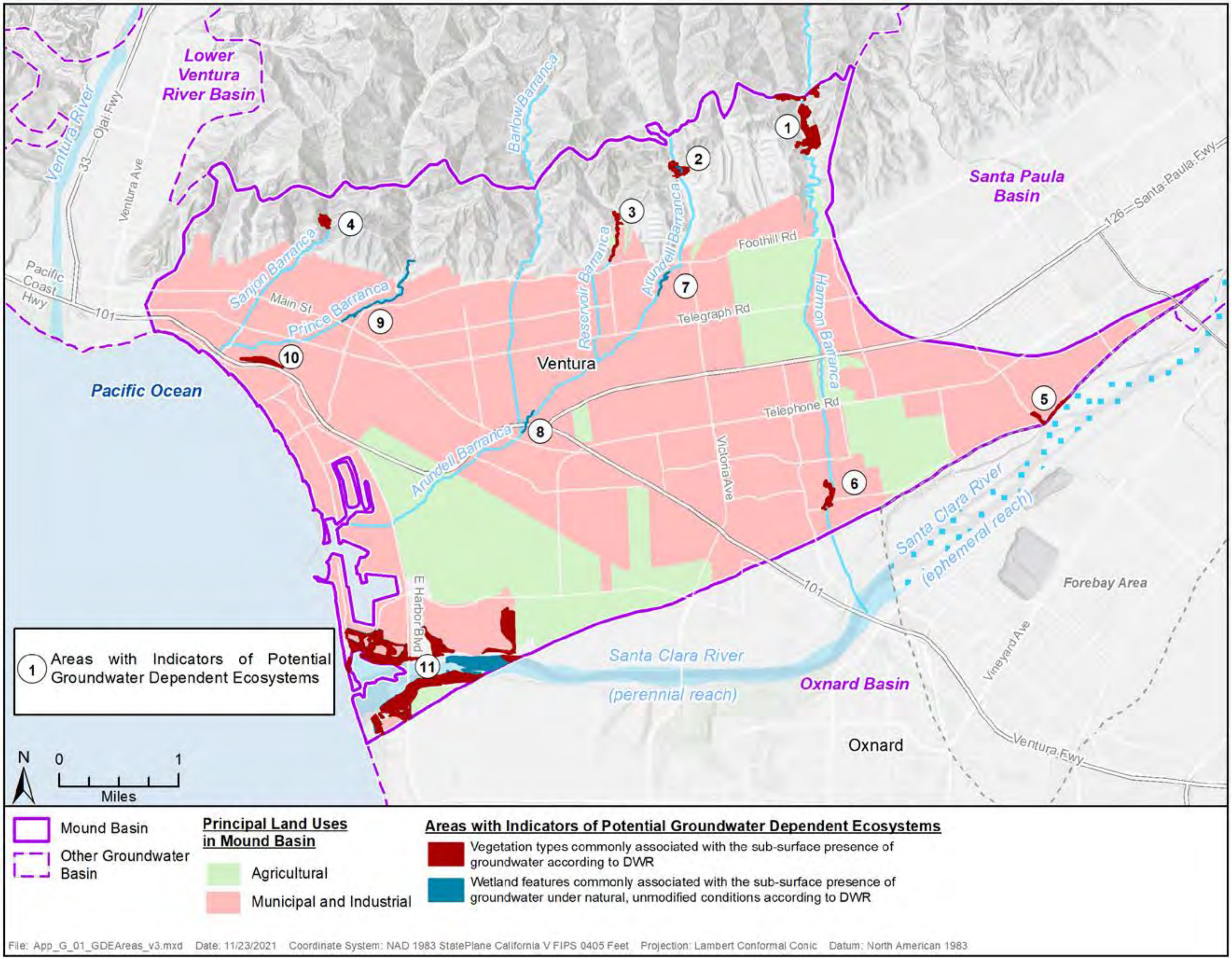


Figure H-1 Map of Areas with Indicators of Potential Groundwater Dependent Ecosystems.

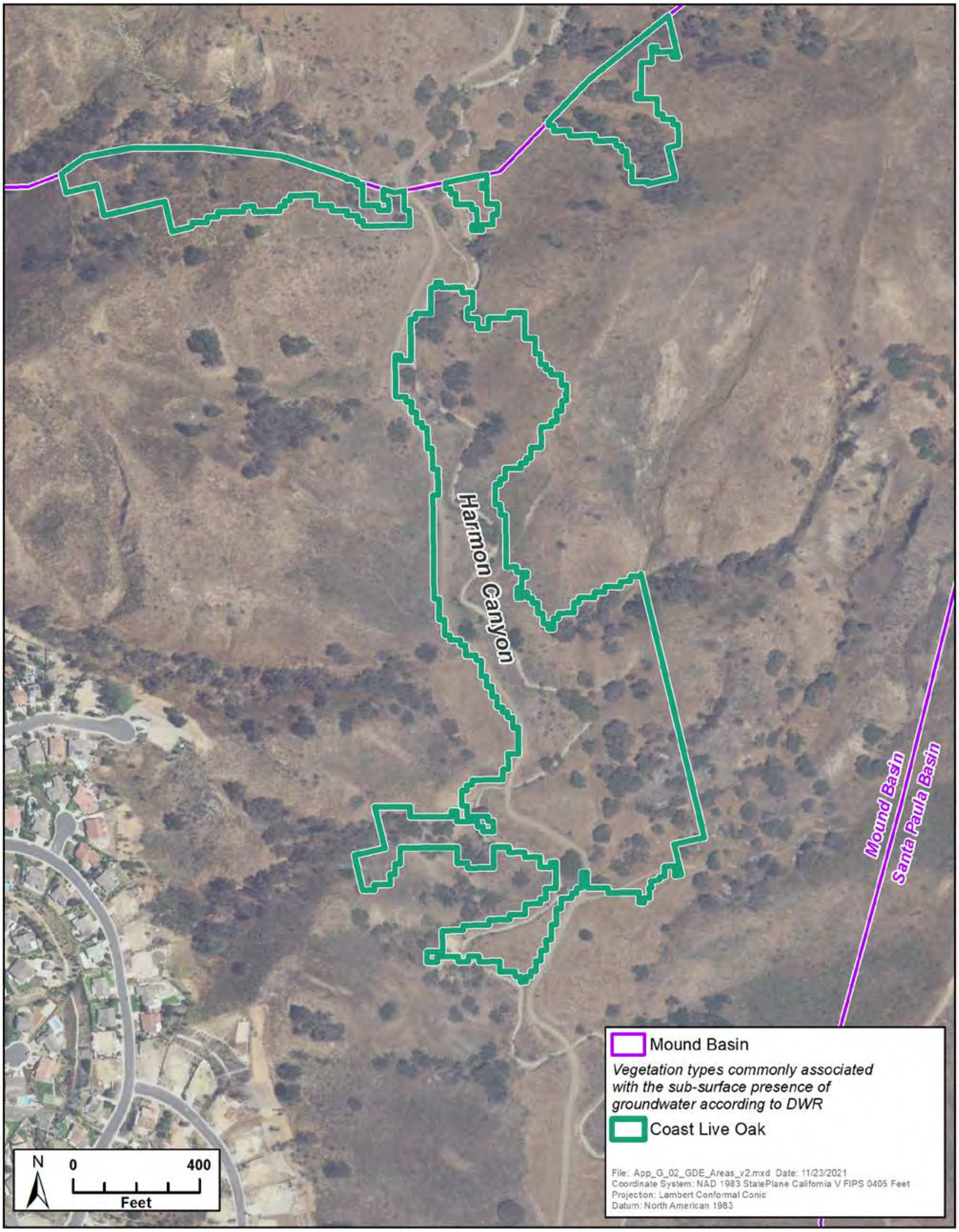
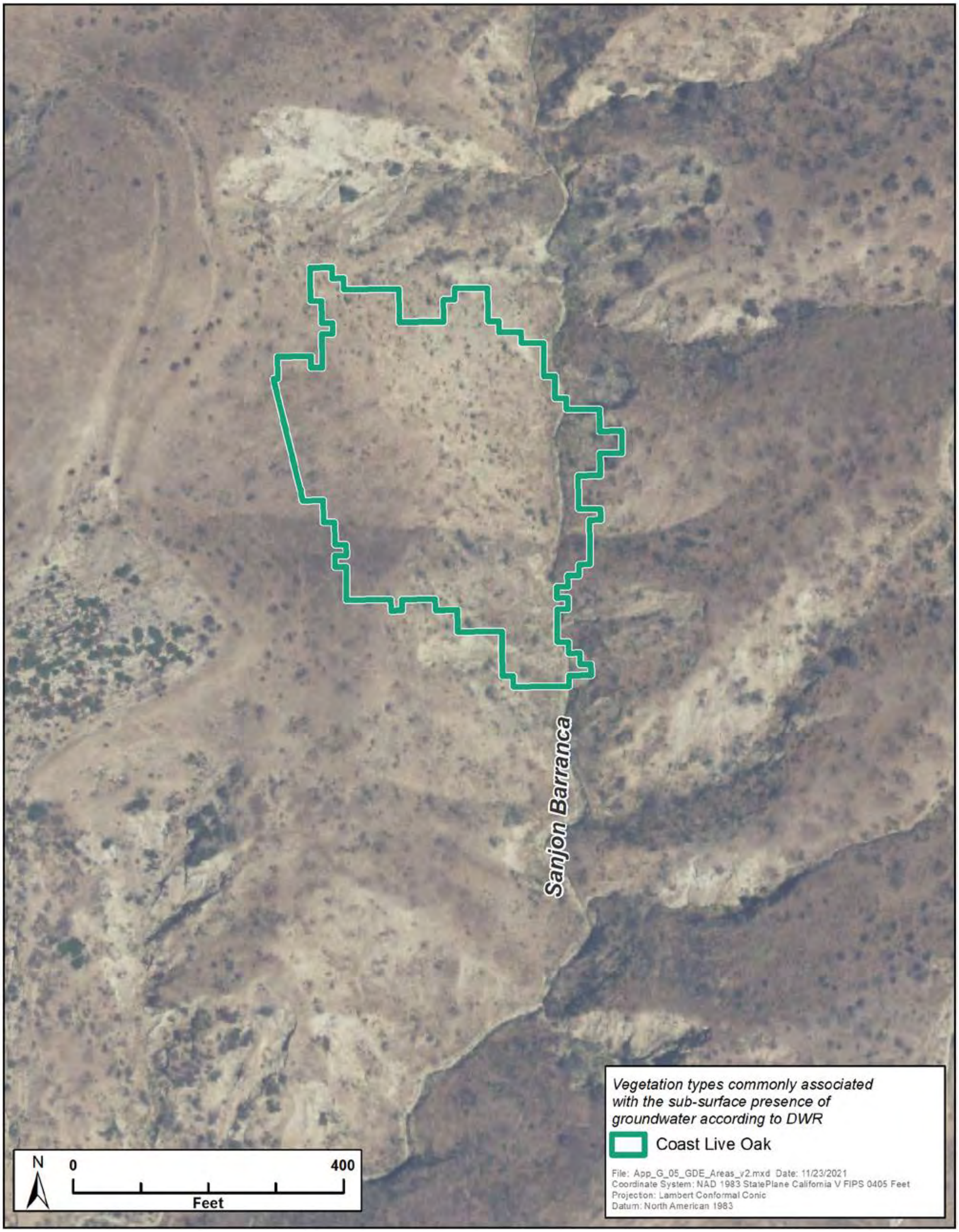


Figure H-2 Potential GDE Area 1.

Figure H-3 Potential GDE Area 2.

Figure H-4 Potential GDE Area 3.

Figure H-5 Potential GDE Area 4.



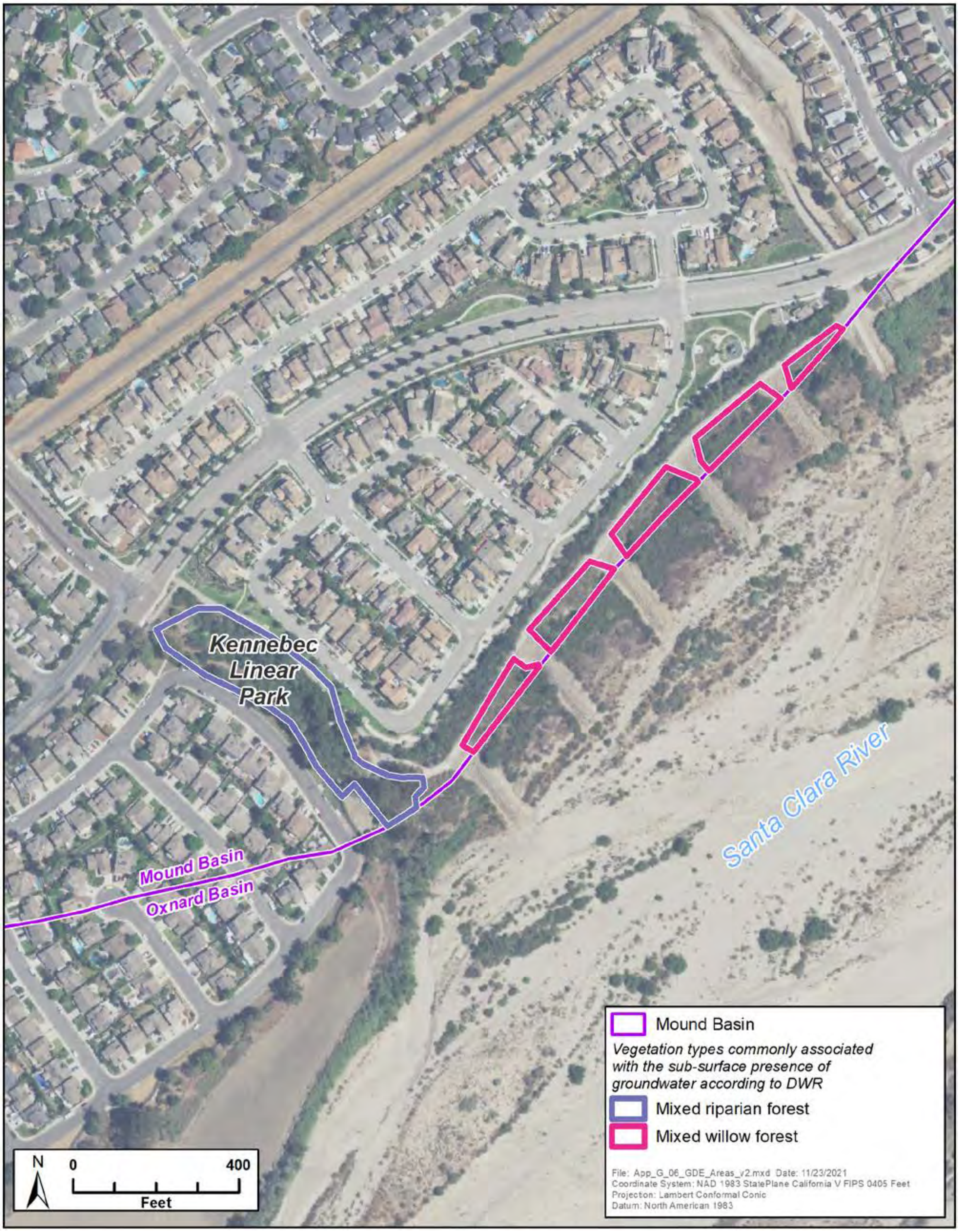


Figure H-6 Potential GDE Area 5.

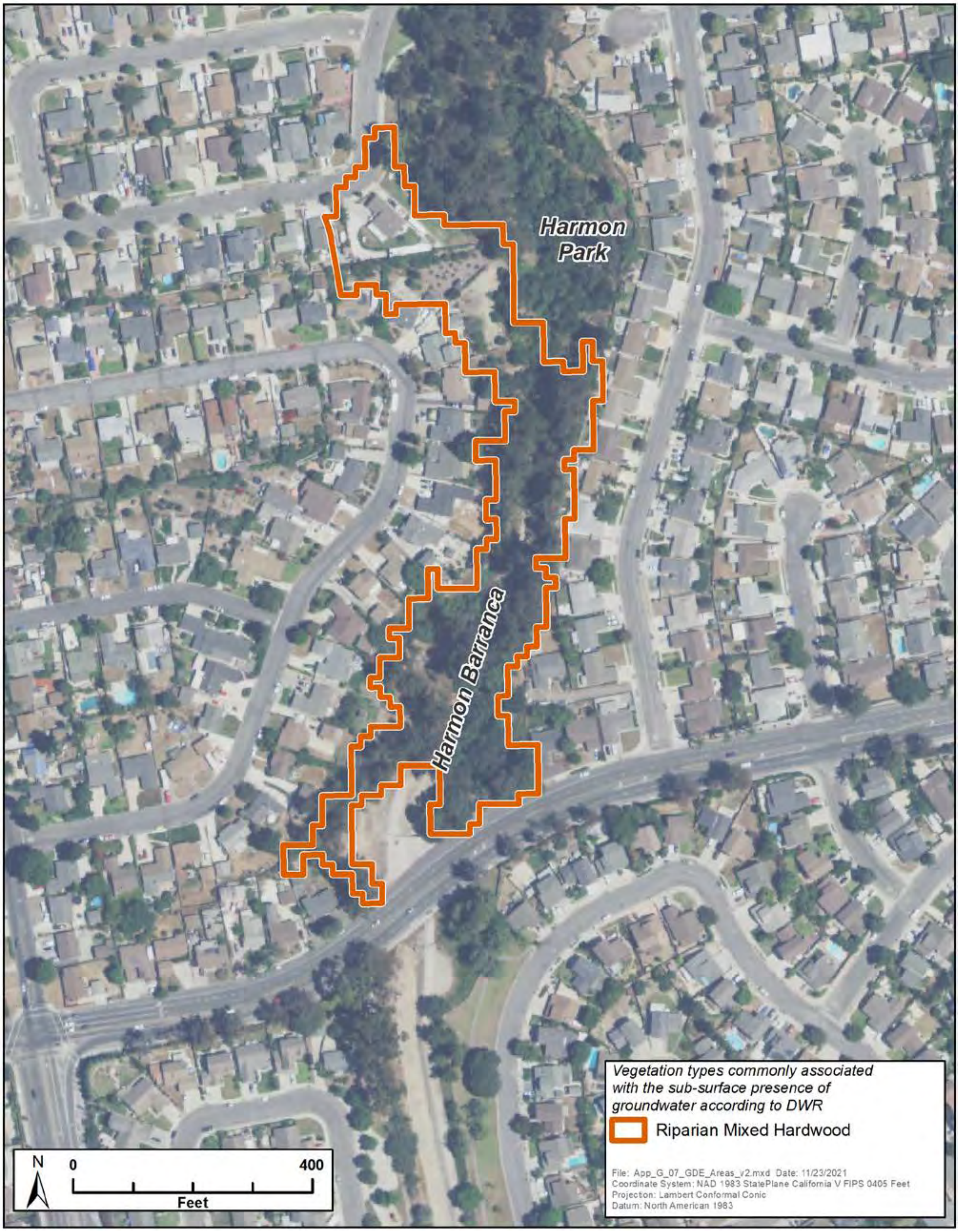


Figure H-7 Potential GDE Area 6.

Figure H-8 Potential GDE Area 7.

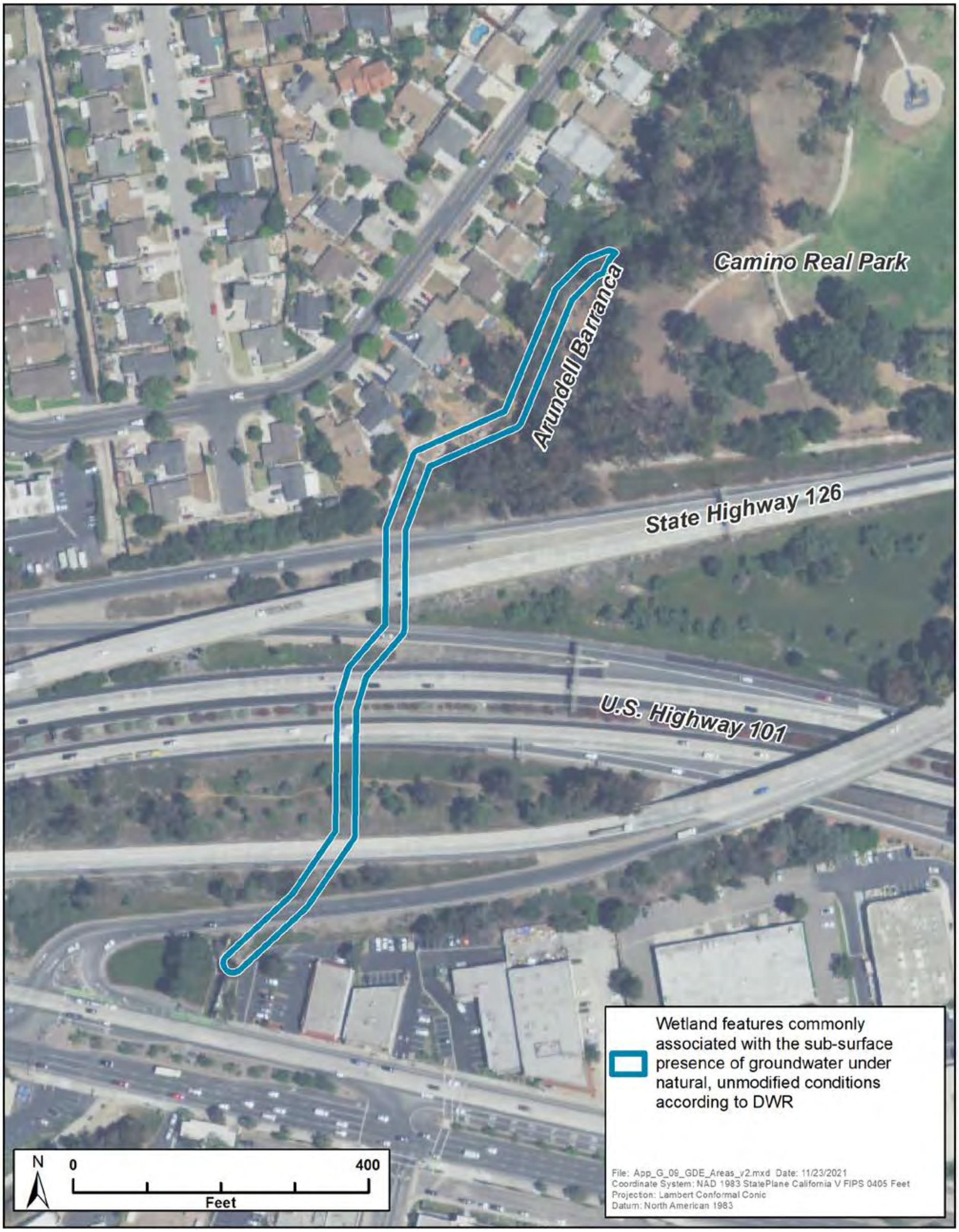


Figure H-9 Potential GDE Area 8.

Figure H-10 Potential GDE Area 9.

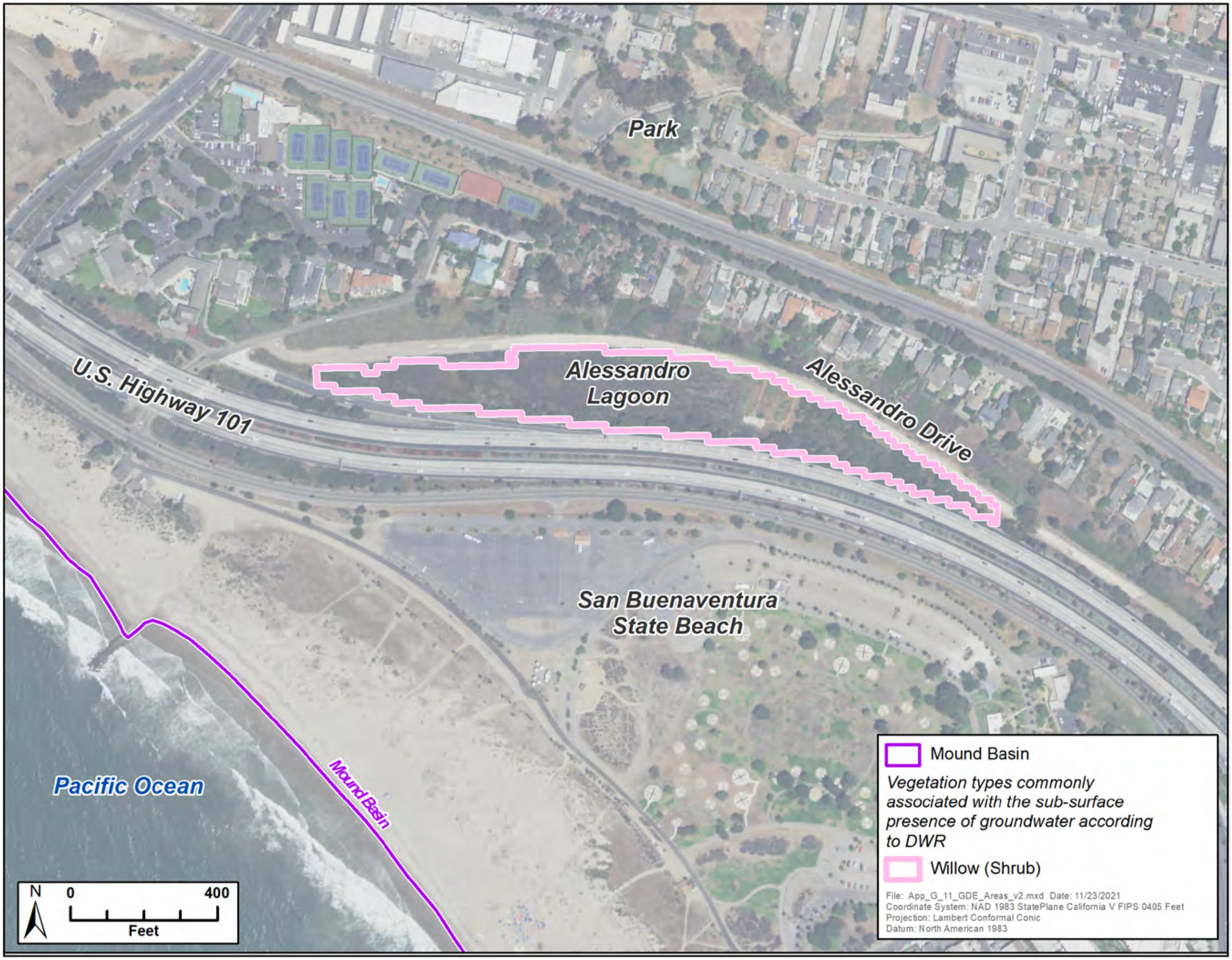


Figure H-11 Potential GDE Area 10.

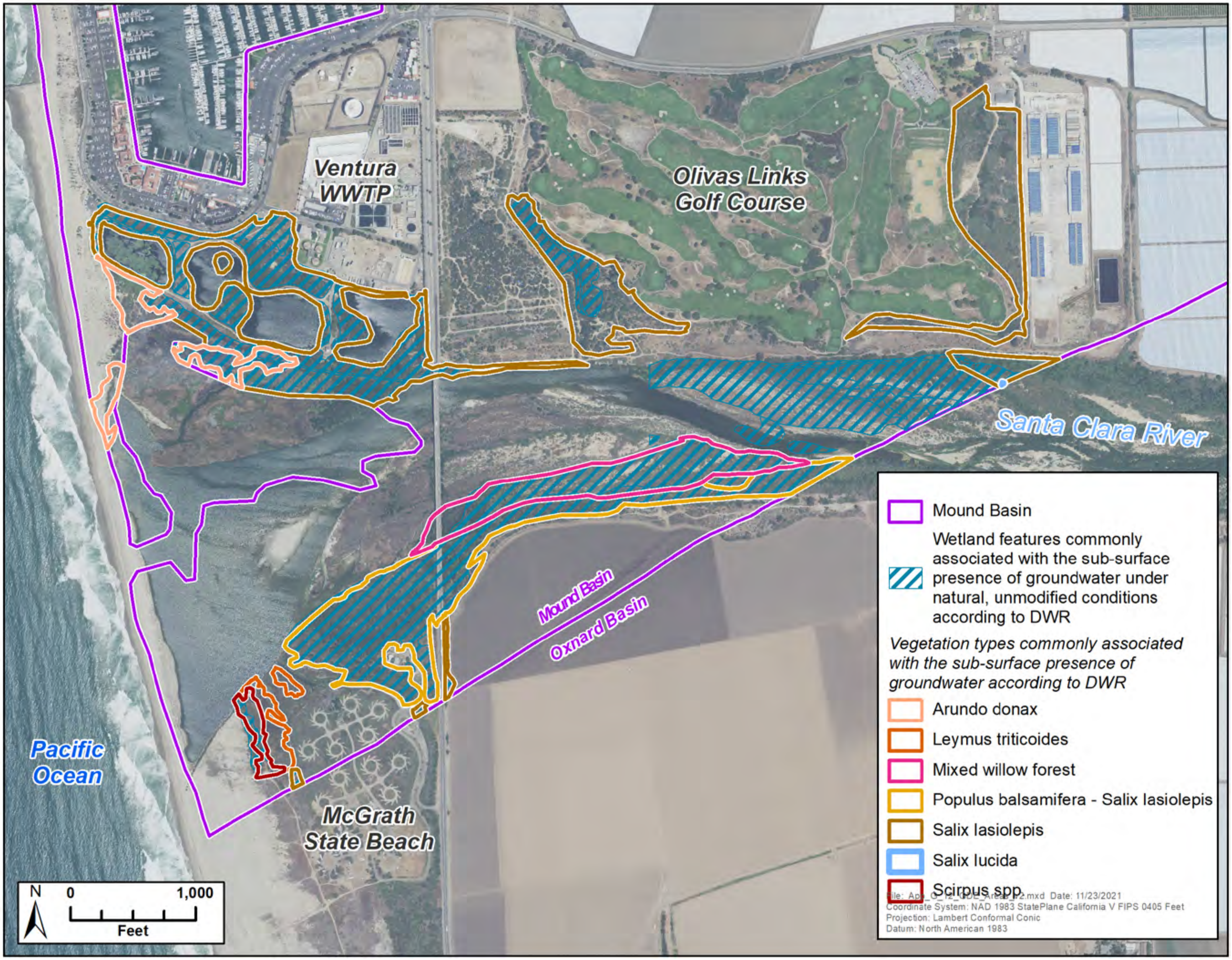
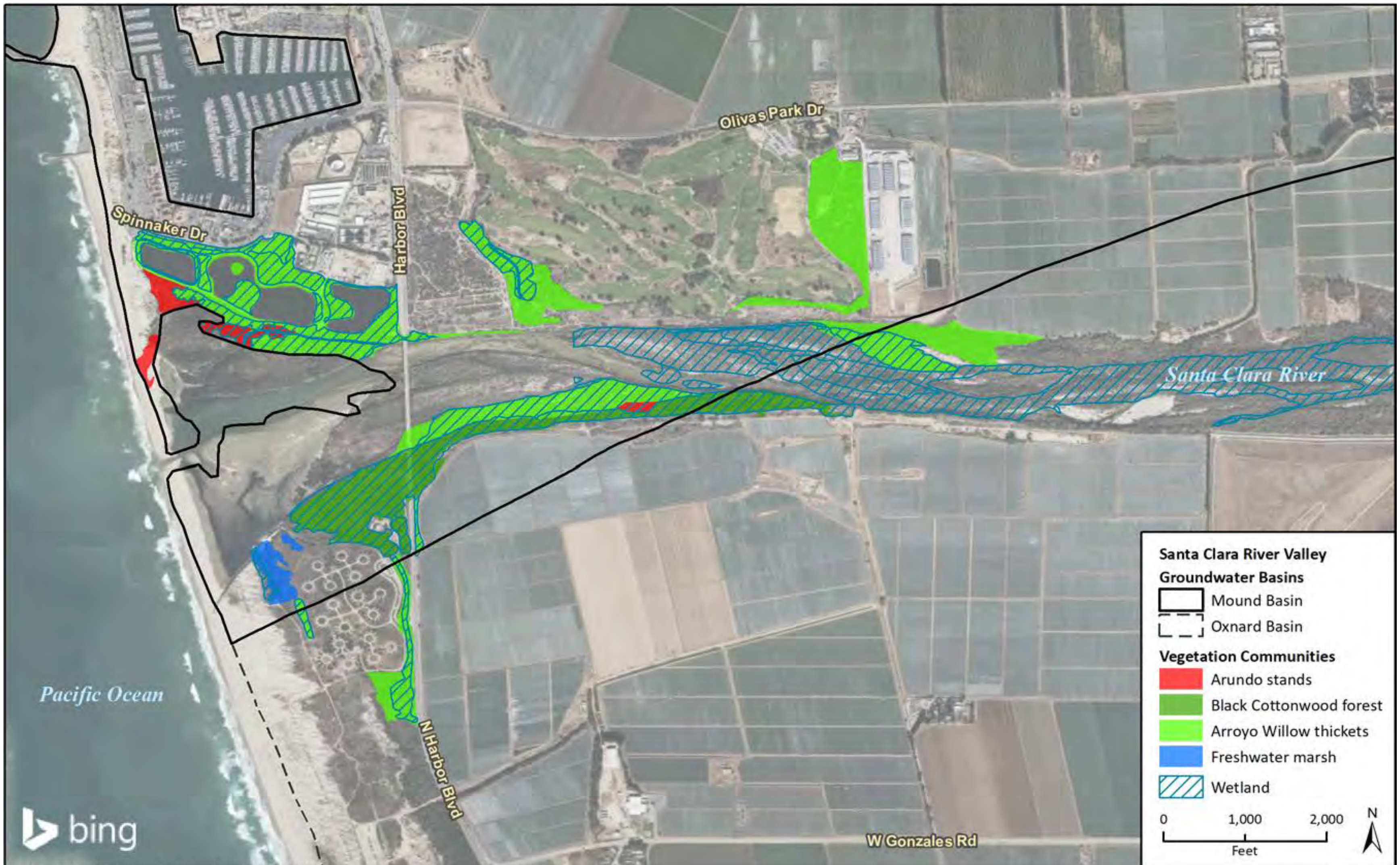


Figure H-12 Potential GDE Area 11.



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Additional data provided by California Natural Resources Agency (CNRA), 2020

Figure H-13 Area 11 Vegetation Communities with Potential to be Groundwater Dependent.

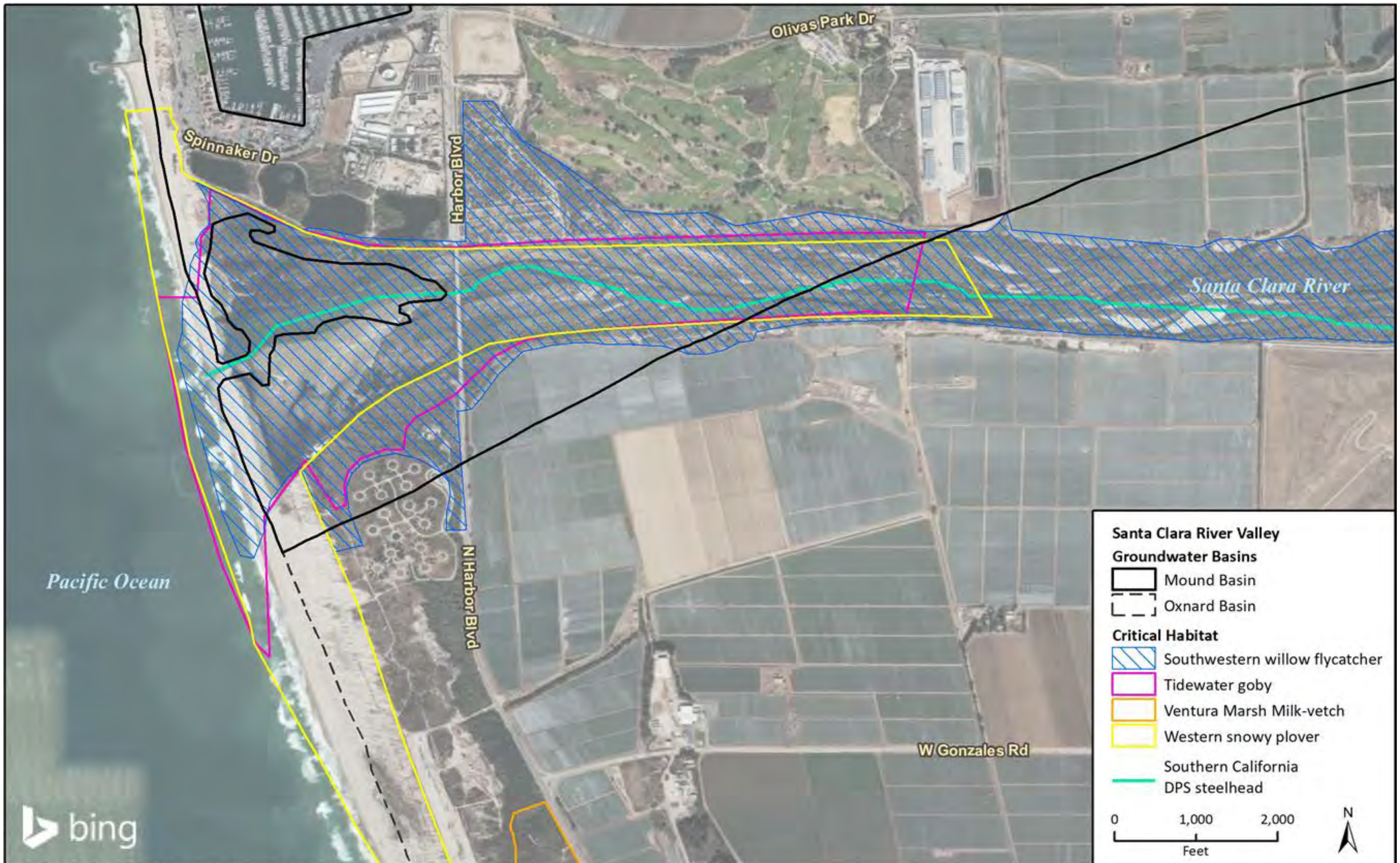

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Figure H-14 Area 11 Critical Habitat.

Attachment H-1. Historic Photo Plate for Areas 1 – 10

Area 1 (1927, 1959, 1964, 2021)

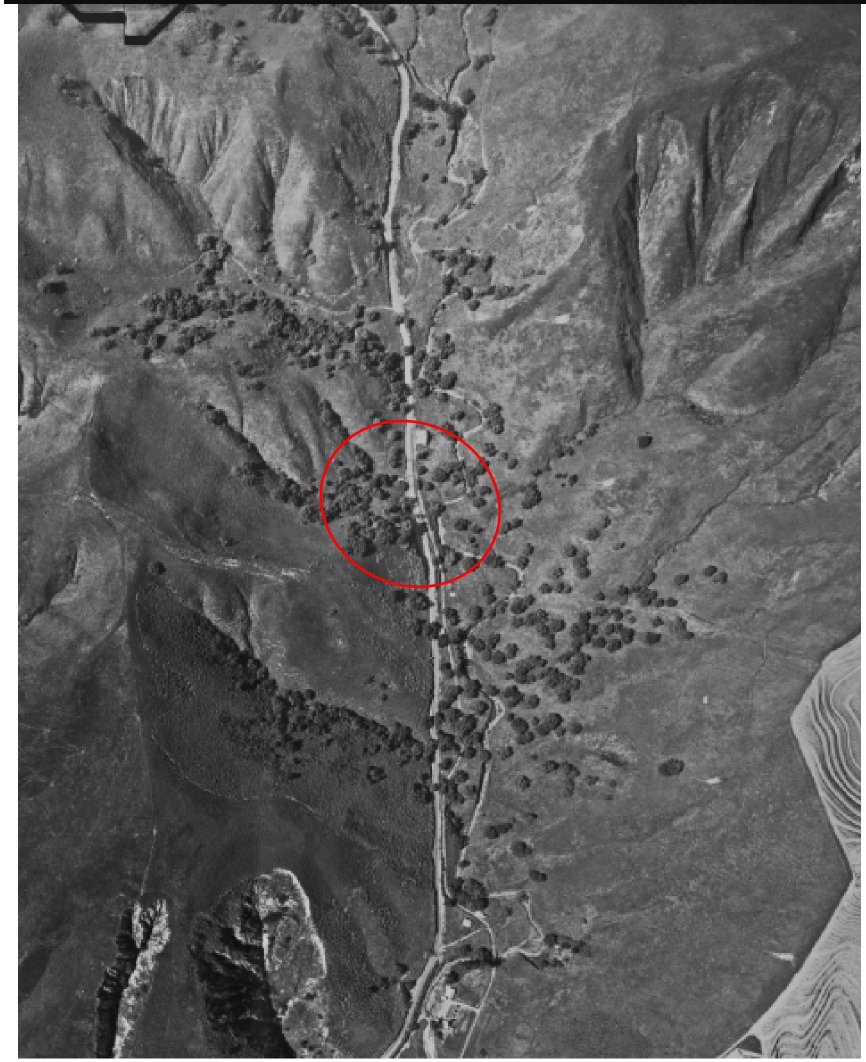
Photograph 1. Area 1, 1927

Photograph 2. Area 1, 1959

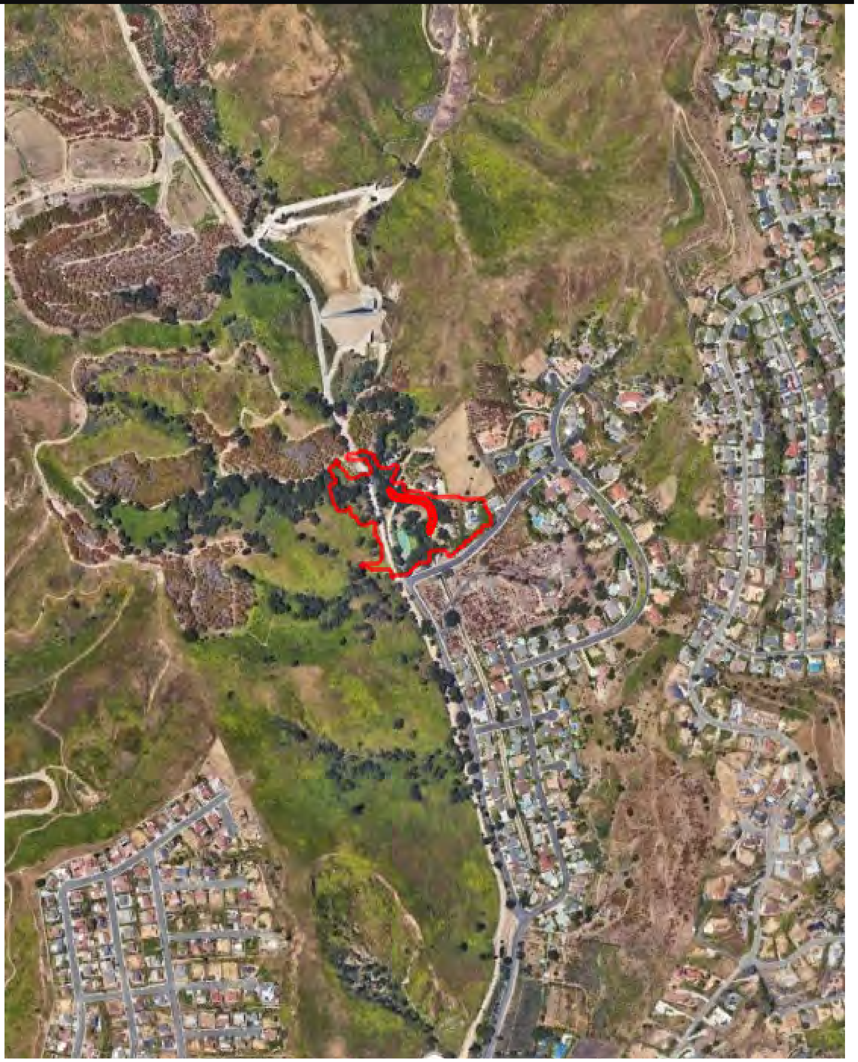
Photograph 3. Area 1, 1964

Photograph 4. Area 1, 2021

Area 2 (1958,2021)



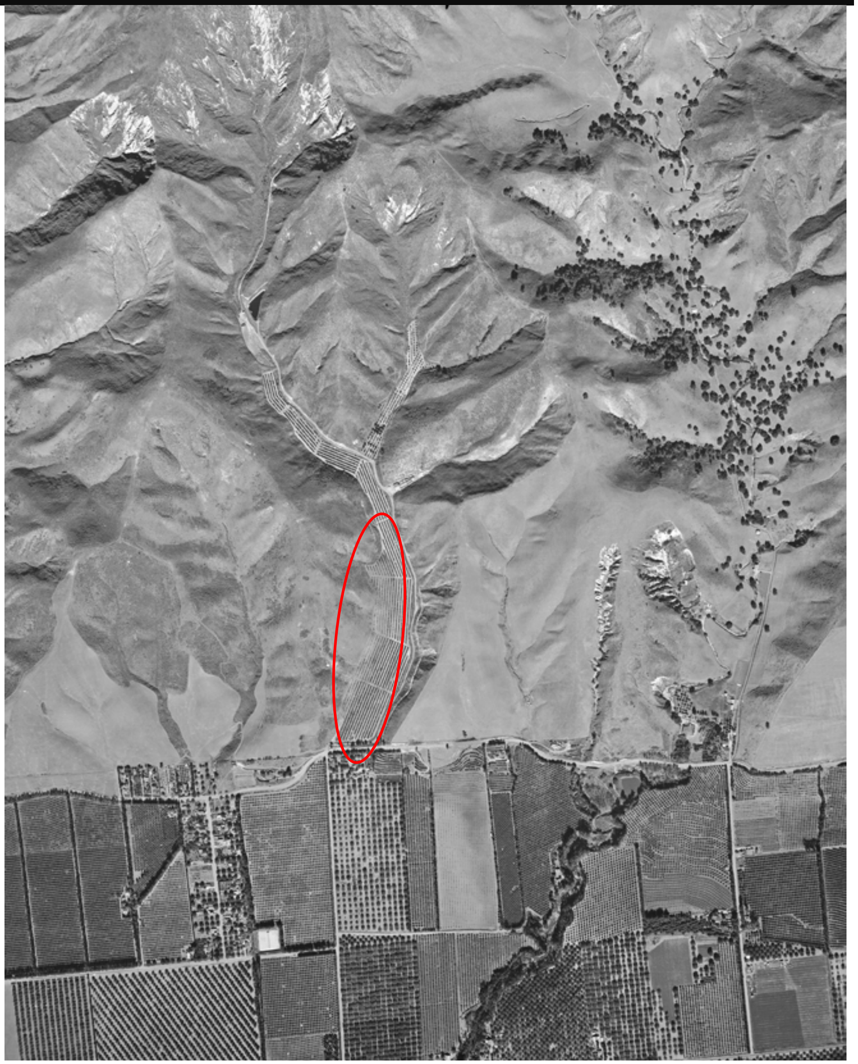
Photograph 5. Area 2, 1958



Photograph 6. Area 2, 2021

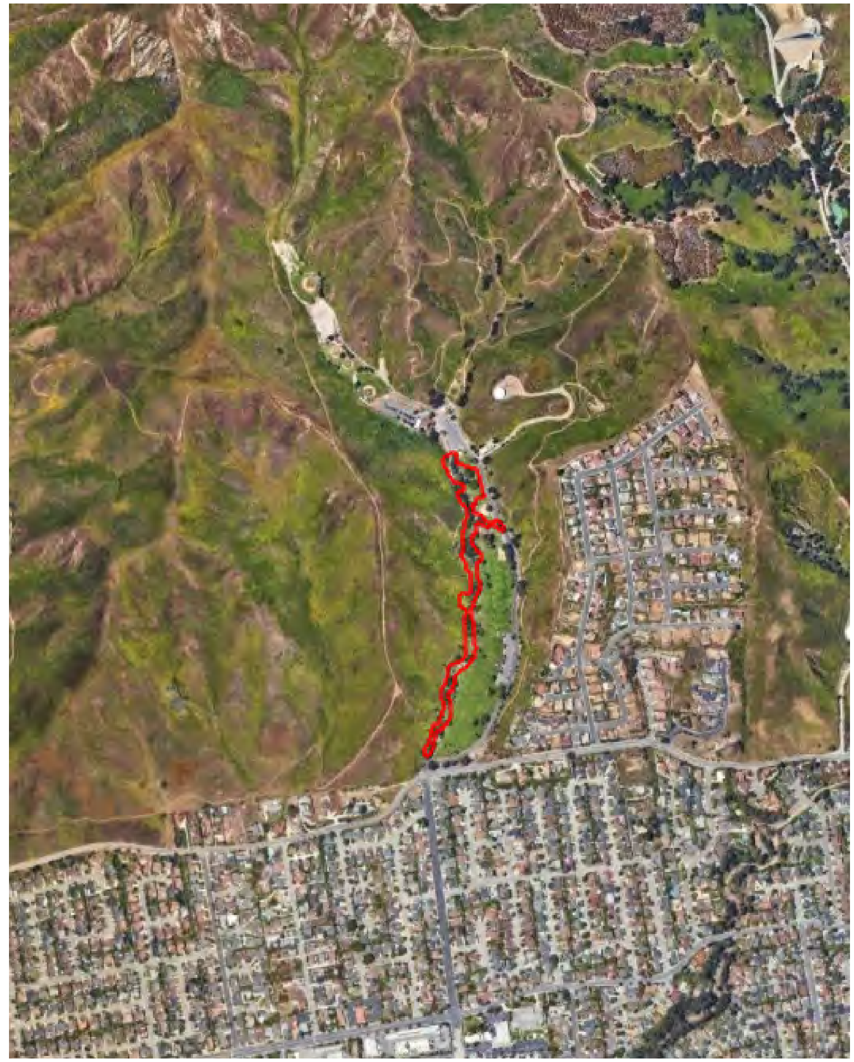
Area 3 (1927, 1945, 1963, 2021)

Photograph 7. Area 3, 1927



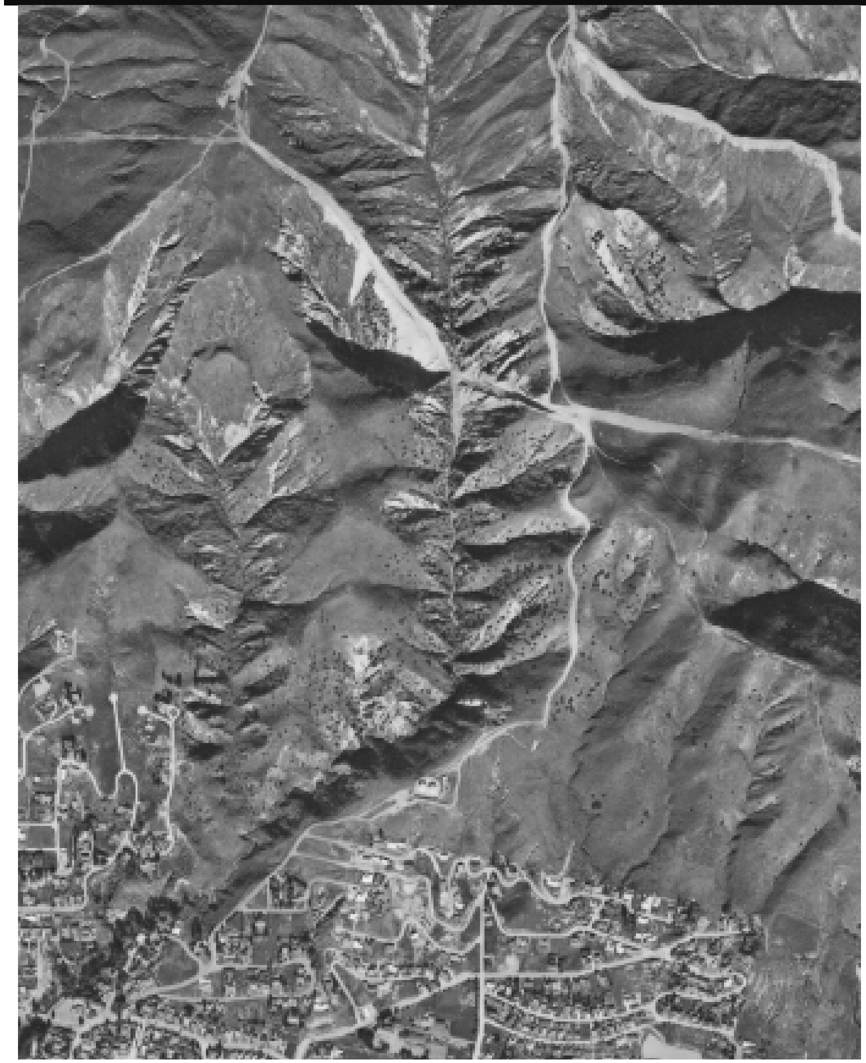
Photograph 8. Area 3, 1945

Photograph 9. Area 3, 1963



Photograph 10. Area 3, 2021

Area 4 (1927, 2021)



Photograph 11. Area 4, 1927

Photograph 12. Area 4, 1996

Photograph 13. Area 4, 2009

Photograph 14. Area 4, 2021

Area 5 (1945, 1958, 1970, 2021)

Photograph 15. Area 5, 1945

Photograph 16. Area 5, 1958

Photograph 17. Area 5, 1970

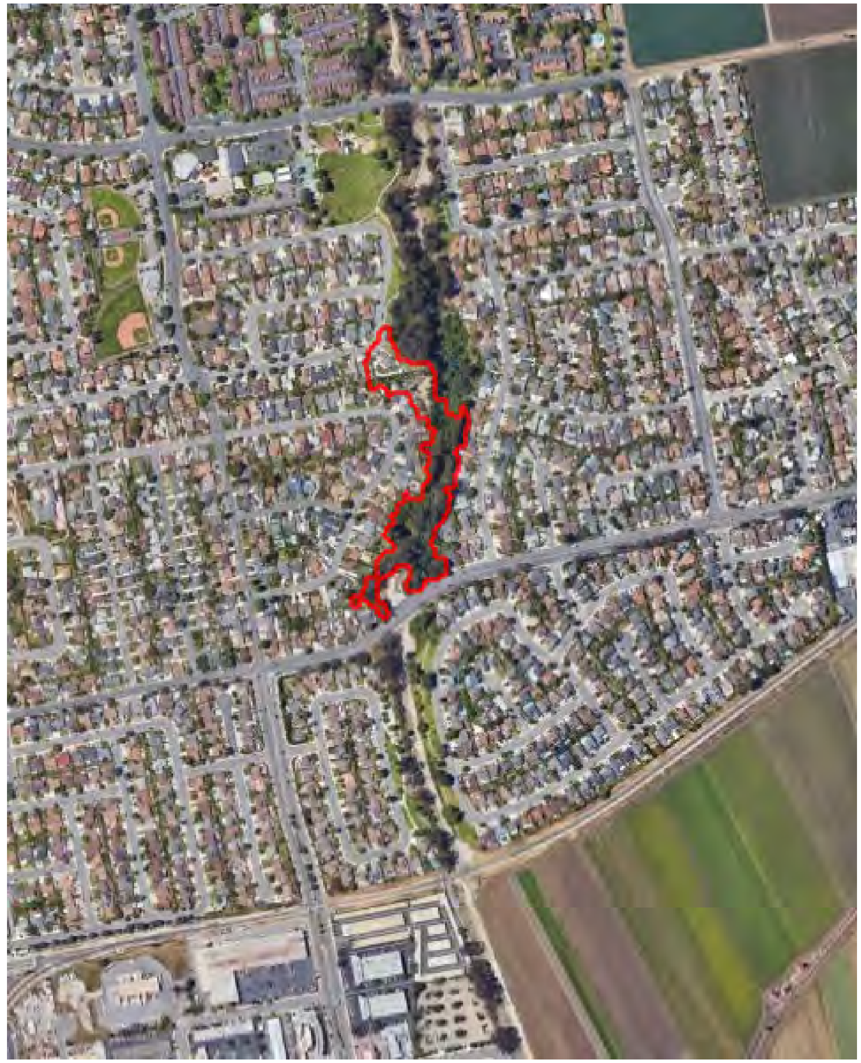
Photograph 18. Area 5, 2021

Area 6 (1927, 1947, 1963, 2021)

Photograph 19. Area 6, 1927

Photograph 20. Area 6, 1947

Photograph 21. Area 6, 1963



Photograph 22. Area 6, 2021

Area 7 (1938, 1961, 1994, 2021)

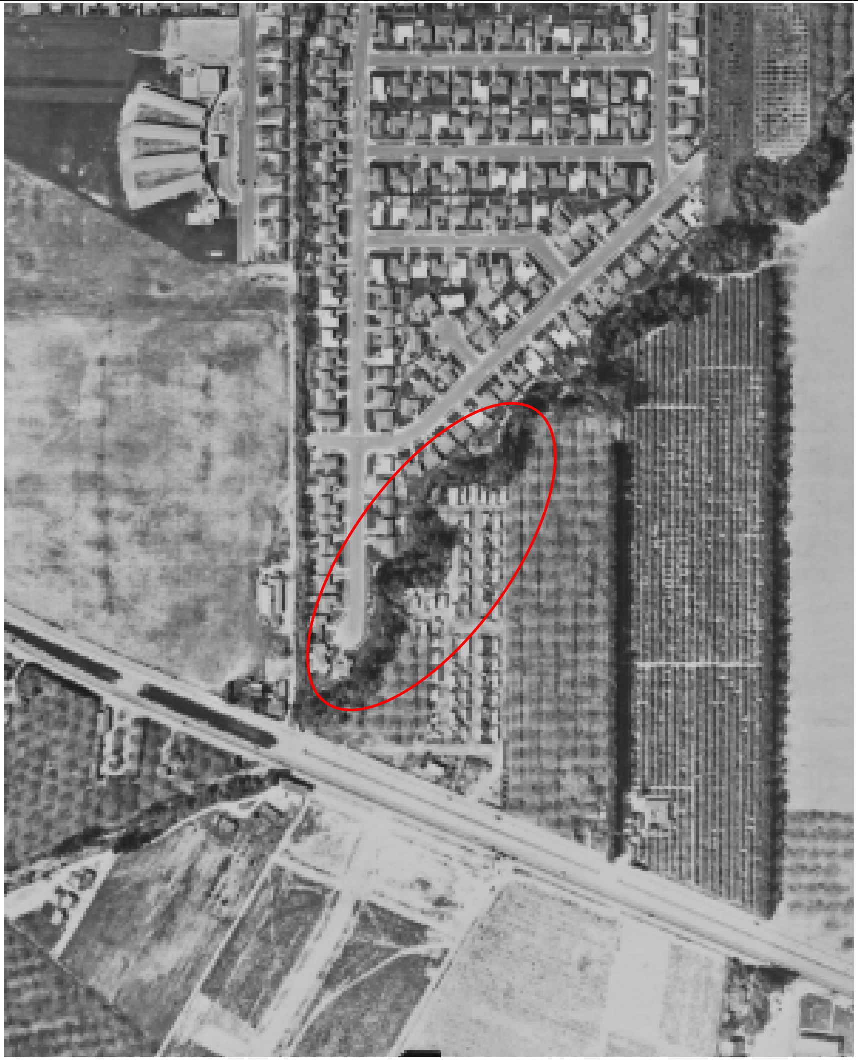
Photograph 23. Area 7, 1938

Photograph 24. Area 7, 1961

Photograph 25. Area 7, 1994

Photograph 26. Area 7, 2021

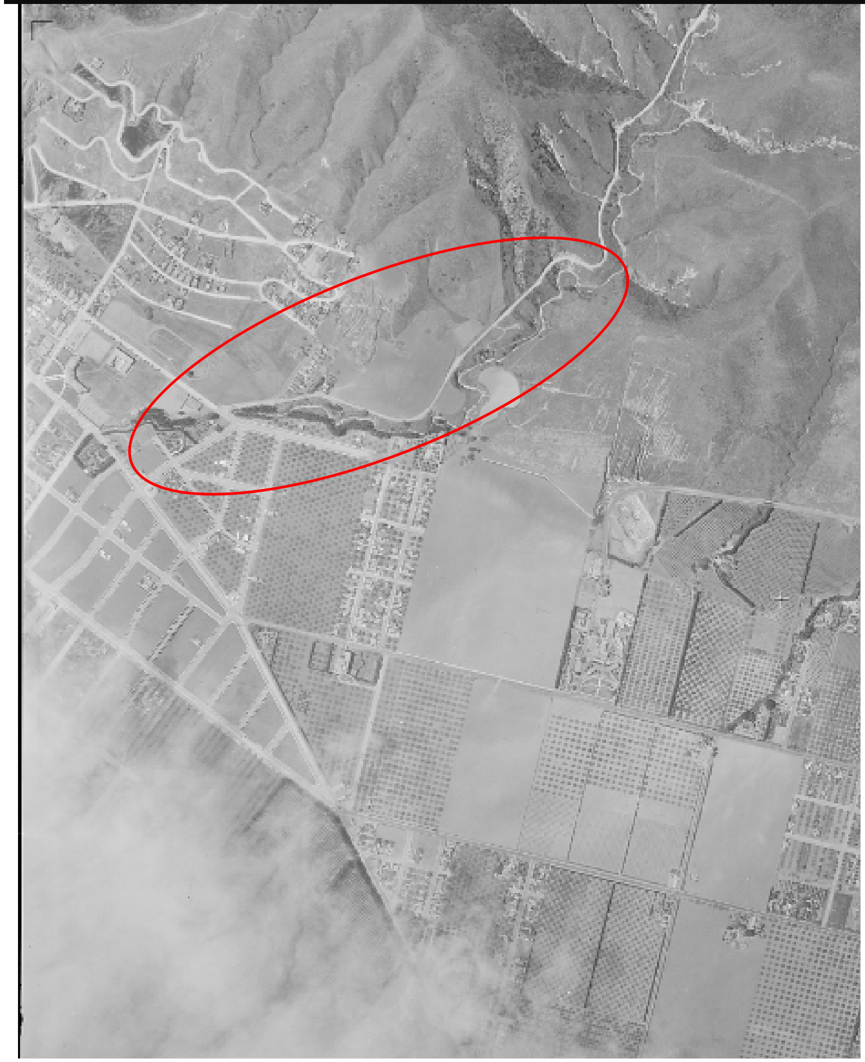
Area 8 (1958, 2021)



Photograph 27. Area 8, 1958

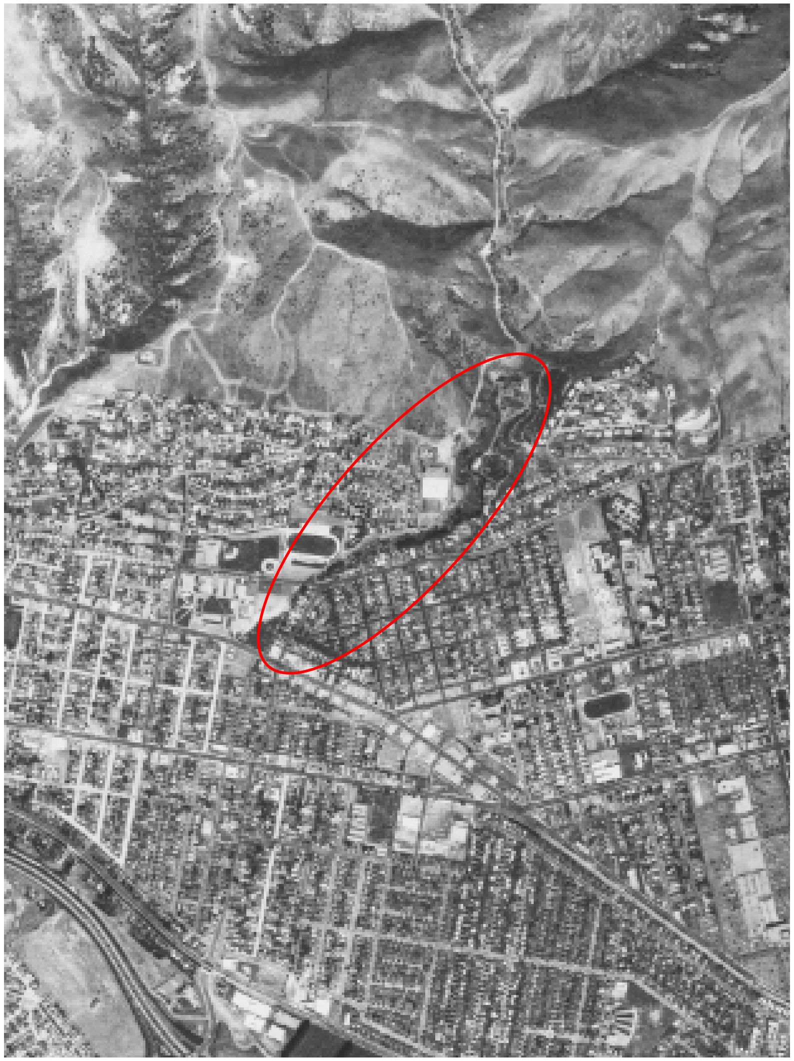
Photograph 28. Area 8, 2021

Area 9 (1938, 1958, 1968, 2021)



Photograph 29. Area 9, 1938

Photograph 30. Area 9, 1958



Photograph 31. Area 9, 1968

Photograph 32. Area 9, 2021

Area 10 (1959, 1964, 1994, 2021)

Photograph 33. Area 10, 1959

Photograph 34. Area 10, 1964

Photograph 35. Area 10, 1994

Photograph 36. Area 10, 2021

Attachment H-2. Evaluation of Special Status Species with Potential to Occur in Mound Basin and Area 11

Evaluation of Special Status Species with Potential to Occur in Mound Basin and Area 11

Data Sources

Rincon queried the following databases for information on special status species and sensitive natural communities with documented occurrences within Mound Basin:

- California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB, CDFW 2021a)
- California Native Plant Society Online Inventory of Rare and Endangered Plants of California (CNPS, 2021)
- Calflora Database (Calflora, 2021)
- eBird Online Database of Bird Distribution and Abundance (Cornell Lab of Ornithology, 2021a)
- California Freshwater Species Database (TNC, 2020)
- VegCAMP (CDFW, 2021d)

Rincon reviewed additional literature for information on special status species and sensitive natural communities with potential to occur within Mound Basin and Area 11, including the following sources:

- CDFW Special Animals List (CDFW, 2021b)
- CDFW Special Vascular Plants, Bryophytes, and Lichens List (CDFW, 2021e)
- CDFW Sensitive Natural Communities List (CDFW, 2021c)
- All About Birds Online Bird Guide (Cornell Lab of Ornithology, 2021b)
- A Manual of California Vegetation, Second Edition, California Native Plant Society (CNPS, 2009)
- Estuary Subwatershed Study Assessment of the Physical and Biological Condition of the Santa Clara River Estuary (Stillwater Sciences, 2011)
- Biological Resources Technical Report, Santa Clara River Estuary Habitat Restoration Project (WRA, 2014)

Evaluation Criteria

The following criteria were used to evaluate the potential for special status species to occur, as well as their potential dependency on groundwater. Due to the presence of important habitat for special status species within and around the SCRE, as well as the uncertainty of material connection of the surface water and shallow groundwater to the managed aquifer, Area 11 was specifically assessed for special status species potential to occur.

- **Present.** The species has been observed by a qualified local biologist within the basin/Area 11 within the past five years and/or has a documented occurrence within the basin within the past five years.

- **Likely to Occur.** Suitable habitat is present within the basin/Area 11 and there are documented occurrences within the basin/Area 11 (or nearby locations with similar habitat) within the past ten years.
- **May Occur.** Some suitable habitat currently exists within the basin/Area 11 and/or there are documented occurrences in the vicinity within the past 20 years.
- **Unlikely to Occur.** Only marginally suitable habitat for the species exists within the basin/Area 11 and/or there are no documented occurrences of the species within basin in the past 30 years.
- **Not Expected.** No suitable habitat for the species exists within the basin/Area 11, the species is considered extirpated in the region, and/or there are no documented occurrences of the species within the basin in the past 30 years.

Special status plant species were classified as either **likely** or **unlikely** to depend on groundwater, and therefore be associated with a Groundwater Dependent Ecosystem (GDE), based on rooting depths, habitat and water requirements, current distribution within the basin and/or the location of documented occurrences within the basin, and depth to water data within areas of documented occurrences.

Wildlife and fish species were evaluated for potential groundwater dependence based on determinations from the Critical Species Lookbook (Rohde et al., 2019) and by evaluating known habitat preferences, life histories, and diets. Species GDE associations were assigned one of three categories:

- **Direct.** Species directly dependent on groundwater for some or all water needs (e.g., juvenile steelhead in dry season).
- **Indirect.** Species dependent upon other species that rely on groundwater for some or all water needs (e.g., riparian birds).
- **No known reliance on groundwater.**

-

Special Status Species Within the Regional Vicinity of Mound Basin

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Plants					
Aphanisma blitoides aphanisma	None/None G3G4/S2 1B.2	Likely to Occur	Coastal bluff scrub, Coastal dunes, Coastal scrub. On bluffs and slopes near the ocean in sandy or clay soils. 1-305m. Blooms Feb-Jun. There is one documented occurrence of the species approximately 2.5 miles northwest of Mound Basin, near Conoco Oil Road (Calflora 2021). Some suitable habitat for the species occurs within Mound Basin and Area 11.	Unlikely	Likely to Occur
Astragalus didymocarpus var. milesianus Miles' milk-vetch	None/None 1B.2	Not Expected	Annual herb. 50-385 m elevation. Occurs in coastal scrub with clay soils. Blooms Mar-Jun. There is one historic occurrence (from 1945) of the species documented approximately 5.5 miles northwest of Mound Basin along Casitas Road, near Casitas Lake (Calflora 2021). Some coastal scrub habitat occurs within the northwestern portion of Mound Basin, but no suitable habitat for the species occurs within Area 11.	Unlikely	Not Expected
Astragalus pycnostachyus var. *lanosissimus* Ventura Marsh milk-vetch	FE/SE 1B.1	Present	Perennial herb. 1-35 m elevation. Occurs in marshes and swamps, coastal dunes, coastal scrub. Within reach of high tide or protected by barrier beaches, more rarely near seeps on sandy bluffs. Blooms Jul-Oct. There are two documented occurrences in Mound Basin, within the SCRE (Calflora 2021). Critical habitat for the species occurs approximately 0.7 mile south of the basin.	Likely	Present

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Atriplex coulteri Coulter's saltbush	None/None G3/S1S2 1B.2	Likely to Occur	Coastal bluff scrub, Coastal dunes, Coastal scrub, valley and foothill grassland. Ocean bluffs, ridgetops, as well as alkaline low places. Alkaline or clay soils. 3-460m. Blooms Mar-Oct. There is one documented occurrence of the species approximately 1.5 miles southwest of the basin (Calflora 2021). Suitable habitat for the species occurs throughout undisturbed portions of the basin and within dune habitat near Area 11.	Unlikely	May Occur
Atriplex pacifica south coast saltscale	None/None G4/S2 1B.2	May Occur	Coastal bluff scrub, Coastal dunes, Coastal scrub, Playas. Alkali soils. 0-140m. Blooms Mar-Oct. Some suitable habitat for the species occurs within the basin, but there is only one historical occurrence (from 1963) documented within ten miles (Calflora 2021). Potentially suitable habitat exists within Area 11 in the foredunes and on the fringes of the estuary.	Unlikely	May Occur
Atriplex serenana var. *davidsonii* Davidson's saltscale	None/None G5T1/S1 1B.2	Unlikely to Occur	Annual herb. Blooms April to October. Coastal bluff scrub, coastal scrub. Alkaline soil. 3-250m (10-820ft). One occurrence of the species was documented in 2001 within the Oxnard USGS quad, southeast of the basin (Calflora 2021). Suitable habitat for the species occurs within the basin, but not within Area 11.	Unlikely	Not Expected
Calochortus fimbriatus Late-flowered mariposa lily	None/None 1B.3	May Occur	Perennial bulbiferous herb. 270-1435 m. Occurs chaparral, cismontane woodland, and riparian woodland in dry, open areas on serpentine soils. Blooms Jun-Aug. Some potentially suitable habitat for the species occurs in the northern portion of the basin, but does not exist within Area 11. The species is documented within the Ventura USGS quad. (Calflora 2021).	Unlikely	Not Expected

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Chaenactis glabriuscula var. *orcuttiana* Orcutt's pincushion	None/None G5T1T2/S1 1B.1	Likely to Occur	Coastal bluff scrub, Coastal dunes. Sandy sites. 0-100m. Blooms Jan-Aug. The species is documented within the Ventura USGS quadrangle and within McGrath State Beach (Calflora 2021). Suitable habitat for the species occurs within Mound Basin and Area 11.	Unlikely	Likely to Occur
Chloropyron maritimum ssp. *maritimum* salt marsh bird's-beak	FE/SE G4?T1/S1 1B.2	May Occur	Occurs in coastal dunes and coastal salt marshes and swamps. This species blooms between May and October, and typically occurs at elevations ranging from 0-30 meters. Suitable habitat for the species occurs within Mound Basin and Area 11. One occurrence of the species was documented within McGrath State Beach in 2005 (Calflora 2021).	Likely	May Occur
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	None/None G4T2/S2 1B.1	May Occur	Annual herb. Blooms February to June. Coastal salt marshes, playas, valley and foothill grassland, vernal pools. Usually found on alkaline soils in playas, sinks, and grasslands. 1-1400m (3-4595ft).The species is documented within the Ventura USGS quadrangle (Calflora 2021).	Likely	May Occur
Malacothrix similis Mexican malacothrix	None/None G2G3/SH 2A	Not Expected	Coastal dunes. 0-40m. Blooms Apr-May. One historic occurrence of the species was documented near Port Hueneme in 1925 (Calflora 2021). Some suitable habitat for the species occurs within Mound Basin and Area 11, though the species is considered possibly extirpated in the region (CDFW 2021a).	Unlikely	Not Expected
Monardella hypoleuca ssp. *hypoleuca* White-veined monardella	None/None 1B.3	Unlikely to Occur	Perennial herb. 50-1280 m. Occurs in chaparral and cismontane woodland on dry slopes. 50-1280 m. Blooms Apr-Nov. Potentially suitable habitat occurs within the northern portion of the basin, but no chaparral or cismontane woodland occurs within Area 11.	Unlikely	Not Expected

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Navarretia ojaiensis Ojai navarretia	None/None 1B.1	Unlikely to Occur	Annual herb. 275-620 m. elevation. Occurs in openings in chaparral and coastal scrub, and in valley and foothill grasslands. Blooms May-Jul. Suitable habitat for the species is present in the northern portion of the basin, but Area 11 is lower than the elevation range of the species.	Unlikely	Not Expected
Pseudognaphalium leucocephalum white rabbit-tobacco	None/None G4/S2 2B.2	Likely to Occur	Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland. Sandy, gravelly sites. 0-2100m. Blooms (Jul) AuH-Nov (Dec). Multiple occurrences of the species are documented within one mile of Mound Basin, within both coastal and upland habitat (Calflora 2021).	Unlikely	May Occur
Invertebrates					
Bombus crotchii Crotch bumble bee	None/SCE	Not Expected	Occurs in coastal California east to the Sierra-Cascade crest and south into Mexico. Food plant genera include: *Antirrhinum, Phacelia, Clarkia, Dendromecon, Eschscholzia,* and *Eriogonum.* Suitable plant food genera are not abundant within Mound Basin.	No known dependence on groundwater	Not Expected
Danaus plexippus pop. 1 monarch - California overwintering population	FC/None G4T2T3/S2S3	Present	Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico. Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby. Multiple roosting sites are documented within the boundaries of Mound Basin (Xerces Society 2021), though none occur within Area 11. While individual monarchs may pass through Area 11, suitable roosting habitat for the species does not occur within the estuary area.	Indirect	May Occur (non-roosting)

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Fish					
Catostomus santaanae Santa Ana sucker	FT/None G1/S1	May Occur	The Santa Ana sucker is found in the Los Angeles, San Gabriel, and Santa Ana watersheds of Southern California, where it is considered native. The species is also found in the Santa Clara River Watershed, though during the recovery planning process there was uncertainty as to whether the species was native to the Santa Clara River. The Santa Clara River population is therefore not currently protected by the USFWS (USFWS 2014). Genetic research conducted by Richmond et al. (2017) later verified the species is most likely native to the Santa Clara River. However, the species remains unprotected by the USFWS in the Santa Clara River. These fish are habitat generalists, but prefer sand-rubble-boulder bottoms, cool, clear water, and algae. Santa Ana suckers are known to occur within the Santa Clara River (CDFW 2021a, Richmond et al. 2017). The species is unlikely to inhabit brackish water within the estuary but may occur within the eastern portions of Area 11, upstream of the saltwater interface.	Direct	May Occur
Eucyclogobius newberryi tidewater goby	FE/None G3/S3	Present	Tidewater gobies occur within brackish water habitats along the California coast from Agua Hedionda Lagoon, San Diego County to the mouth of the Smith River in Del Norte County. Found in shallow lagoons and lower stream reaches, they need fairly still but not stagnant water and high oxygen levels and salinities typically between 12 and 28 ppt. Tidewater goby are present within the SCRE (USFWS 2005). Critical habitat for tidewater goby exists within the SCRE and falls within the basin and Area 11.	Direct	Present

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Entosphenus tridentatus Pacific lamprey	None/None SSC	Present	Occurs in freshwater systems and requires adequate flows for migration, suitable substrate (i.e., gravels) for spawning, and adequate cover for pre-spawning holding. Juveniles (called ammocoetes) spend an extended period of time (between four and ten years) rearing while burrowed in sediments filter feeding on organic material and require suitable cover, flow, foraging conditions, and cool temperatures. Juvenile migrant (called macropthalmia) emigration (i.e., outmigration to the ocean) requires water conditions suitable for migration (i.e., water velocity and water depth, dissolved oxygen levels within the surface water, and water temperature suitable for passage). The lower Santa Clara River serves primarily as a migration corridor for Pacific lamprey (Puckett and Villa 1985). Adults, as well as macropthalmia and ammocoetes, have been captured at the Vern Freeman Diversion, which is located approximately 10 miles upstream of the SCRE. However, only a few ammocoetes have been observed within the river basin in recent years (Swift and Howard 2009). Pacific lamprey could be present within Mound Basin and Area 11, especially when the estuary is open to the ocean and immigration and emigration can occur.	Direct	Present
Gasterosteus aculeatus williamsoni unarmored threespine stickleback	FE/SE G5T1/S1 FP	Not Expected	Weedy pools, backwaters, and among emergent vegetation at the stream edge in small Southern California streams. Cool (<24 C), clear water with abundant vegetation. The species range is now restricted to a 14 km stretch of the Soledad Canyon portion of the Upper Santa Clara River and upper San Francisquito Canyon (USFWS 1985, Buth et al. 1984). The species is therefore present upstream of Mound Basin but is not expected to occur within the basin.	Direct	Not Expected

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Gila orcuttii arroyo chub	None/None SSC (Non-Native to Santa Clara River)	May Occur	Native to streams from Malibu Creek to San Luis Rey River basin. Introduced into streams in Santa Clara, Ventura, Santa Ynez, Mojave & San Diego river basins. Inhabits slow water stream sections with mud or sand bottoms. Feeds heavily on aquatic vegetation and associated invertebrates. Known to be common and widely distributed in some of the streams in which it was introduced, including the Santa Clara River (CDFW 2015, Nautilus 2005). While this fish is a SSC, the Santa Clara River is not currently considered part of its native range. The species is unlikely to inhabit brackish water within the estuary but may occur within the eastern portions of Area 11, upstream of the saltwater interface.	Direct	May Occur
Oncorhynchus mykiss irideus pop. 10 Southern California DPS steelhead	FE/None	Present	Occurs in freshwater systems and requires adequate water conditions suitable for migration (i.e., flow, dissolved oxygen levels within the surface water, and water temperature suitable for passage) and suitable substrate (i.e., gravels) for spawning. Juvenile *O. mykiss* require suitable cover, flow, foraging conditions, and cool temperatures for rearing. Juvenile emigration (i.e., outmigration to the ocean) requires water conditions suitable for migration. Steelhead are known to occur within the Santa Clara River (NMFS 2012, Dagit et al. 2019). The lower Santa Clara River serves primarily as a migration corridor for steelhead (Puckett and Villa 1985). The entire Santa Clara River, from the ocean upstream to impassible barriers, is designated critical habitat for steelhead.	Direct	Present

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Amphibians					
Rana boylii foothill yellow-legged frog	None/SE G3/S3 SSC	Not Expected	Prefers partly shaded, shallow streams and riffles with a rocky substrate in a variety of habitats. Needs at least some cobble-sized substrate for egH-laying and sunny streamside banks. Needs at least 15 weeks to attain metamorphosis. There is one historic occurrence of the species (from 1940) documented in the CNDDB within the Ventura USGS quadrangle, but the species is now considered extirpated in the Santa Clara River (CDFW 2021a).	Direct	Not Expected
Rana draytonii California red-legged frog	FT/None SSC	May Occur	Occurs in lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11-20 weeks of permanent water for larval development. Must have access to estivation habitat. There are no documented occurrences of CRLF within the SCRE area in the CNDDB (CDFW 2021a). The species was not documented during amphibian surveys conducted on the Santa Clara River and is thought to only occur within the watershed within several upland tributaries (Santa Clara River Trustee Council 2008). However, suitable riparian habitat for the species occurs within Mound Basin and Area 11.	Direct	May Occur
Reptiles					
Anniella ssp. California legless lizard	None/None G3G4/S3S4 SSC	Likely to Occur	Contra Costa County south to San Diego, within a variety of open habitats. This element represents California records of *Anniella* not yet assigned to new species within the *Anniella pulchra* complex. *Anniella pulchra* are considered present within the vicinity of the SCRE (Stillwater 2011, WRA 2014) and may occur within foredune habitat within Mound Basin and Area 11.	Indirect	Likely to Occur

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Anniella stebbinsi Southern California legless lizard	None/None G3/S3 SSC	Likely to Occur	Generally south of the Transverse Range, extending to northwestern Baja California. Occurs in sandy or loose loamy soils under sparse vegetation. Disjunct populations in the Tehachapi and Piute Mountains in Kern County. Variety of habitats; generally in moist, loose soil. They prefer soils with a high moisture content. Six occurrences of the species are documented in the CNDDB along the shore just south of Mound Basin and Area 11 (CDFW 2021a).	Indirect	Likely to Occur
Aspidoscelis tigris stejnegeri coastal whiptail	None/None G5T5/S3 SSC	May Occur	Found in deserts and semi-arid areas with sparse vegetation and open areas. Also found in woodland & riparian areas. Ground may be firm soil, sandy, or rocky. One occurrence of the species is documented within the CNDDB approximately 1.2 miles north of Mound Basin (CDFW 2021a). Potentially suitable habitat for the species occurs within Mound Basin and Area 11.	Indirect	May Occur
Actinemys pallida (Emys marmorata) Southwestern pond turtle	None/None SSC	May Occur	Occurs in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with basking sites. Feeds on aquatic plants, invertebrates, worms, frog and salamander eggs and larvae, crayfish, and occasionally frogs and fish. Relies on surface water that may be supported by groundwater (Rhode et al. 2019). There are no readily available data on occurrences within Mound Basin. However, suitable habitat does occur upstream of the estuary and the species could be present upstream of the salt wedge.	Direct	May Occur

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Phrynosoma blainvillii coast horned lizard	None/None G3G4/S3S4 SSC	May Occur	Frequents a wide variety of habitats, most common in lowlands along sandy washes with scattered low bushes. Open areas for sunning, bushes for cover, patches of loose soil for burial, and abundant supply of ants and other insects. There are multiple occurrences of the species documented in the CNDDB within the vicinity of Mound Basin, several within the Santa Clara River bed, upstream of Area 11 (CDFW 2021a). Some suitable habitat for the species occurs throughout undisturbed portions of Mound Basin. Potentially suitable habitat for the species occurs within foredunes in Area 11.	No known dependance on groundwater	May Occur
Thamnophis hammondii Two-striped gartersnake	None/None SSC	Likely to Occur	Highly aquatic snake species. Found in or near permanent fresh water, often along streams with rocky beds and riparian vegetation. Prey includes fish, fish eggs, tadpoles, newt larvae, small frogs and toads, leeches, and earthworms. There are five occurrences of the species documented in the CNDDB northwest of Mound Basin, within the Ventura River watershed (CDFW 2021a). Suitable riparian habitat for the species occurs within Mound Basin and Area 11.	Direct	Likely to Occur
Birds					
Agelaius tricolor tricolored blackbird	None/ST G1G2/S1S2 SSC	Present	Highly colonial species, most numerous in Central Valley & vicinity. Largely endemic to California. Requires open water, protected nesting substrate, and foraging area with insect prey within a few kilometers of the colony. Cattail (*Typha* spp.) stands are present within the Santa Clara Estuary (Stillwater 2011), which could provide suitable foraging and nesting habitat for the species. Multiple occurrences of the species are documented within the basin and within Area 11 (Cornell Lab of Ornithology 2021a).	Indirect	Likely to Occur

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Athene cunicularia burrowing owl	None/None G4/S3 SSC	Present	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel. Suitable habitat for the species exists within the basin and there are multiple occurrences documented within the basin and near Area 11 (Cornell Lab of Ornithology 2021a).	No known dependence on groundwater	Likely to Occur
Charadrius nivosus western snowy plover	FT/None G3T3/S2 SSC	Present	Sandy beaches, salt pond levees & shores of large alkali lakes. Needs sandy, gravelly or friable soils for nesting. Numerous occurrences of the species are documented along the coastline within Mound Basin and known nesting habitat for the species exists in and around the SCRE (Cornell Lab of Ornithology 2021a). Critical habitat for the species is designated within Area 11.	No known dependence on groundwater	Present
Circus hudsonius northern harrier	None/None G5/S3 SSC	Present	Occurs in coastal salt & freshwater marsh. Nest and forage in grasslands, from salt grass in desert sink to mountain cienagas. Nests on ground in shrubby vegetation, usually at marsh edge; nest built of a large mound of sticks in wet areas. The species was observed within the SCRE during biological surveys conducted in 2014 (WRA 2014). Numerous occurrences of the species are also documented within Mound Basin and Area 11 in eBird (Cornell Lab of Ornithology 2021a). Suitable nesting and foraging habitat for the species occurs within Area 11.	Indirect	Present

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Coccyzus americanus occidentalis western yellow-billed cuckoo	FT/SE G5T2T3/S1	May Occur	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems. Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape. There is one documented occurrence of the species (from 2020) within the Ventura Settling Ponds in the western portion of the basin, just north of Area 11 (Cornell Lab of Ornithology 2021a). Some potential breeding habitat for the species occurs within Area 11, though no individuals were detected within the basin during surveys conducted in 2018 and 2019 (Hall et al. 2020).	Indirect	May Occur
Elanus leucurus white-tailed kite	None/None G5/S3S4 FP	Present	Often found in rolling foothills and valley margins with scattered oaks & river bottomlands or marshes next to deciduous woodland. Also occurs in open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching. The species was observed within SCRE during biological surveys conducted in 2014 (WRA 2014). Numerous occurrences of the species are also documented within Mound Basin and Area 11 in eBird (Cornell Lab of Ornithology 2021a). Suitable foraging habitat and potentially suitable nesting habitat for the species occurs within Area 11.	Indirect	Present

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Empidonax traillii extimus Southwestern willow flycatcher	FE/SE	May Occur	Occurs in dense brushy thickets within riparian woodland often dominated by willows and/or alder, near permanent standing water. Reliant on groundwater-dependent riparian vegetation, including for nest sites that are typically located near slow-moving streams, or side channels and marshes with standing water and/or wet soils (Rohde et al. 2019). Feeds on insects, fruits, and berries. There are no occurrences of the species documented within the CNDDB or eBird within the basin (CDFW 2021a, Cornell Lab of Ornithology 2021a). The species was documented within the Santa Clara River channel, upstream of the basin, during avian population surveys in 2005 and 2006 (Labinger et al. 2011). Some potential nesting habitat for the species exists within Area 11, though no individuals were detected within the basin during surveys conducted in 2018 and 2019 (Hall et al. 2020). The Santa Clara River channel and estuary are designated critical habitat for the southwestern willow flycatcher.	Indirect	May Occur
Falco peregrinus anatum American peregrine falcon	FD/SD G4T4/S3S4 FP	Present	Near wetlands, lakes, rivers, or other water; on cliffs, banks, dunes, mounds; also, human-made structures. Nests consist of a scrape or a depression or ledge in an open site. One known nest site exists within the Oxnard USGS quadrangle (CDFW 2021a). Numerous occurrences of the species are documented within the basin and Area 11 (Cornell Lab of Ornithology 2021a, WRA 2014). The Santa Clara estuary and surrounding beach provide high quality foraging habitat for the species, though suitable nesting habitat is not present within Area 11.	Indirect	Present (foraging)

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Laterallus jamaicensis coturniculus California black rail	None/ST G3G4T1/S1 FP	Not Expected	Inhabits freshwater marshes, wet meadows and shallow margins of saltwater marshes bordering larger bays. Needs water depths of about 1 inch that do not fluctuate during the year and dense vegetation for nesting habitat. Suitable habitat for the species occurs within the basin and Area 11, but there are no documented occurrences within Ventura County since 1936 (CDFW 2021a, Cornell Lab of Ornithology 2021a).	Direct	Not Expected
Passerculus sandwichensis beldingi Belding's savannah sparrow	None/SE G5T3/S3	Present	Inhabits coastal salt marshes, from Santa Barbara south through San Diego County. Nests in Salicornia on and about margins of tidal flats. Multiple occurrences of the species are documented within Mound Basin and Area 11 (Cornell Lab of Ornithology 2021a).	Indirect	Present
Polioptila californica coastal California gnatcatcher	FT/None G4G5T3Q/S2 SSC	Unlikely to Occur	Obligate, permanent resident of coastal sage scrub below 2500 ft in Southern California. Low, coastal sage scrub in arid washes, on mesas and slopes. Not all areas classified as coastal sage scrub are occupied. There is one occurrence of the species documented in eBird within Area 11 in 2018 (Cornell Lab of Ornithology 2021a). Two historical occurrences (in 1872 and 1906) of the species are documented within the basin in the CNDDB (CDFW 2021a).	Indirect	Unlikely to Occur
Riparia bank swallow	None/ST G5/S2	Present	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole. Multiple occurrences of the species are documented within the basin and near Area 11 (WRA 2014, Cornell Lab of Ornithology 2021a). One historic occurrence (1976) is documented in McGrath State Beach in the CNDDB (CDFW 2021a).	Indirect	Present

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Setophaga petechia Yellow warbler	None/None SSC	Present	Inhabits riparian plant associations in close proximity to water. Also nests in montane shrubbery in open conifer forests in Cascades and Sierra Nevada. Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders. There are multiple observations of the species documented within the basin and Area 11 in eBird (Cornell Lab of Ornithology 2021a). There are two recent occurrences (2016 and 2017) of the species documented within the vicinity of the basin in the CNDDB (CDFW 2021a). The species was also detected within the lower reaches of the Santa Clara River during avian population surveys conducted in 2005 and 2006 (Labinger et al. 2011).	Indirect	Present
Sternula antillarum browni California least tern	FE/SE G4T2T3Q/S2 FP	Present	Nests along the coast from San Francisco Bay south to northern Baja California. Colonial breeder on bare or sparsely vegetated, flat substrates: sand beaches, alkali flats, landfills, or paved areas. There are multiple observations of the species documented within the basin and Area 11 in eBird (Cornell Lab of Ornithology 2021a). Suitable nesting habitat for the species occurs within Area 11.	Indirect	Present

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Vireo bellii pusillus Least Bell's vireo	FE/SE G5T2/S2	Present	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy. This species relies on groundwater-dependent vegetation in riparian areas, particularly during breeding periods (Rohde et al. 2019). Eats insects, fruits, and berries. Multiple occurrences of the species are documented within the basin and near Area 11 (Cornell Lab of Ornithology 2021a). Multiple occurrences of the species were also documented upstream of the estuary during avian population surveys conducted in 2005 and 2006 (Labinger et al 2011). Suitable nesting habitat for the species occurs within Area 11.	Indirect	Present
Mammals					
Antrozous pallidus pallid bat	None/None G4/S3 SSC	Unlikely to Occur	Found in a variety of habitats including deserts, grasslands, shrublands, woodlands, and forests. Most common in open, dry habitats with rocky areas for roosting. Roosts in crevices of rock outcrops, caves, mine tunnels, buildings, bridges, and hollows of live and dead trees which must protect bats from high temperatures. Very sensitive to disturbance of roosting sites. Only one historic occurrence of the species (from 1906) is documented in the CNDDB within the vicinity of mound Basin (CDFW 2021a).	No known dependence on groundwater	Unlikely to Occur

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Chaetodipus californicus femoralis Dulzura pocket mouse	None/None SSC	Not Expected	Inhabit a variety of habitats including coastal scrub, chaparral & grassland (primarily in San Diego County). Attracted to grass-chaparral edges. Specimens were collected northeast of Mound Basin at unknown dates, but presumably not within recent decades. One male and one female were collected within near Meiner's Oaks at an unknown date. Another female was collected near Weldon Canyon at an unknown date (CDFW 2021a). There are no other documented occurrences of the species within Mound Basin.	No known dependence on groundwater	Not Expected
Choeronycteris mexicana Mexican lonH-tongued bat	None/None G3G4/S1 SSC	Not Expected	Common throughout Mexico, this species is occasionally found in San Diego and Imperial Counties. Feeds on nectar and pollen of night-blooming succulents. Roosts in desert canyons, caves, and rock crevices. Also uses abandoned buildings. canyons, deep caves, mines, or rock crevices. There is one historic occurrence of the species (in 1994) documented just north of Mound Basin in the CNDDB (CDFW 2021a). Suitable habitat for the species is not present within Area 11.	No known dependence on groundwater	Not Expected
Eumops perotis californicus Western mastiff bat	None/None SSC	Not Expected	Occurs in open, semi-arid to arid habitats, including coniferous and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roosts in crevices in cliff faces and caves, and buildings. Roosts typically occur high above ground. One occurrence of the species was documented in 1907 near Weldon (CDFW 2021a).	No known dependence on groundwater	Not Expected

Scientific Name Common Name	Status	Potential to Occur within Mound Basin	Habitat Requirements and Documented Occurrences within Mound Basin	GDE Association	Potential to Occur within Area 11 of Mound Basin
Taxidea taxus American badger	None/None G5/S3 SSC	Unlikely to Occur	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils for digging burrows. Needs sufficient food, friable soils and open, uncultivated ground. Preys on burrowing rodents. There is some potentially suitable habitat for the species within hills in the northwestern portion of Mound Basin, though the species is more likely to occur in open habitat inland of the basin. No suitable habitat for the species occurs within Area 11.	No known dependence on groundwater	Not Expected

Regional Vicinity refers to the three USGS quadrangles surrounding Mound Basin (Ventura, Oxnard, and Saticoy)

FE = Federally Endangered

FT = Federally Threatened

SSC= CDFW Species of Special Concern

SE = State Endangered

ST = State Threatened

SCE = State Candidate Endangered

FP = State Fully Protected

CRPR (California Rare Plant Rank)

1A=Presumed Extinct in California

1B=Rare, Threatened, or Endangered in California and elsewhere

2A=Plants presumed extirpated in California, but more common elsewhere

2B=Plants Rare, Threatened, or Endangered in California, but more common elsewhere

CRPR Threat Code Extension

.1=Seriously endangered in California (over 80% of occurrences threatened/high degree and immediacy of threat)

.2=Fairly endangered in California (20-80% occurrences threatened)

.3=Not very endangered in California (<20% of occurrences threatened)

CDFW Rare

G1 or S1 = Critically Imperiled Globally or Subnationally (state)

G2 or S2 = Imperiled Globally or Subnationally (state)

G3 or S3 = Vulnerable to extirpation or extinction Globally or Subnationally (state)

G4/5 or S4/5 = Apparently secure, common and abundant

GNR/SNR= Globally or Subnationally (state) not ranked

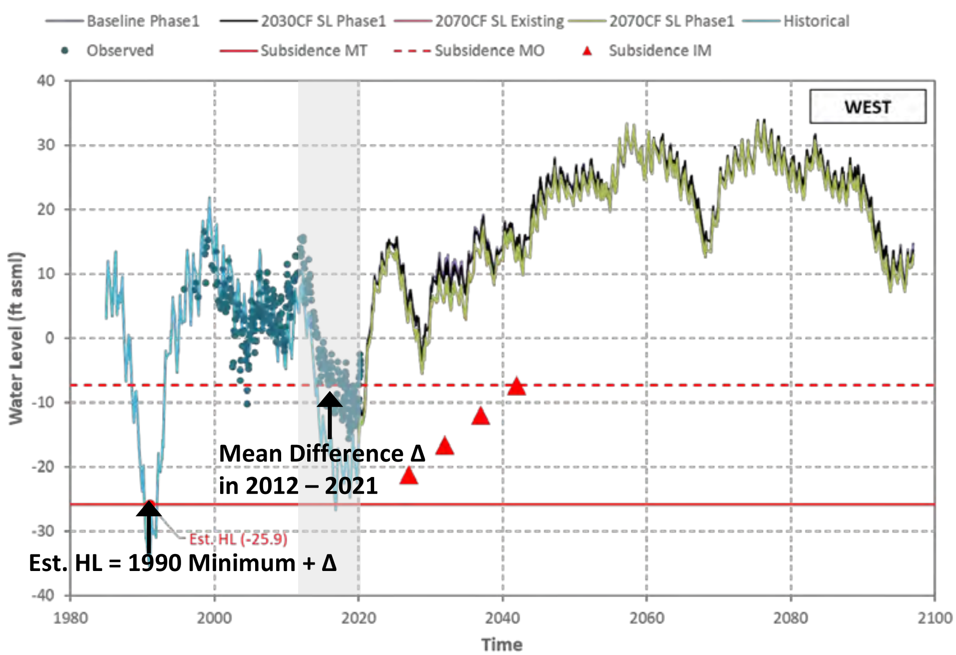
Appendix I

Time Series Plots of Measured Groundwater Level Data with Model Calibration and Predictive Simulations with Minimum Thresholds and Measurable Objectives

APPENDIX I

Method for Establishing Groundwater Level Historical Lows (HL)

Measured and modeled groundwater level data was analyzed for the Mound Basin monitoring network (Figures I-1 and I-2). The observed groundwater level (GWL) data contained two notable periods of historical lows (HL), one near the year 1990 and one near the year 2020. When a well had low GWL measurements near 1990, the lowest of those measurements was selected as HL for that well (e.g., Hueneme Well 02N22W09K04S; Figure I-3). When a well did not have an observed GWL measurement near 1990, the HL was estimated using the modeled GWL because the modeled HL was typically lower at 1990 than near 2020 (with the exception of two wells in the Mugu aquifer). This estimation method first calculated the mean difference between the observed and simulated data in the 2012 – 2021 period (this period was used because the last peak GWL before 2021 occurred near 2012), and then the mean difference was added to the lowest simulated GWL near 1990 (e.g., see annotated figure for Hueneme Well 02N23W15J01S below).



There were two exceptions to this HL estimation method, the Mugu wells 02N22W08G01S and 02N22W19M04S (Figures I-16 and I-20, respectively). For these wells, the estimated HL using modeled GWL ended up being higher than the observed HL measurement near 2020, so the HL near 2020 was used instead.

Minimum Thresholds (MT)

Chronic Lowering of Groundwater Levels MT:
Initially, the Groundwater Supply Depletion Water Level Threshold was estimated (Table I-1): for each Mugu well, a fixed height of 40 ft was added and the estimated drawdown (estimated pumping rate divided by specific capacity; 2000/60 ≈ 33 ft) to the top elevation of the aquifer at that well location. Similarly, for each Hueneme well, a fixed height of 40 ft was added and the estimated drawdown (2000/83 ≈ 24 ft) to the top elevation of the aquifer at that well location. The drawdown estimates are based on the historical data and the 2000 gpm pumping assumption.

Table I-1. Groundwater Supply Depletion Water Level Thresholds

Well ID	Aquifer	Aquifer Top Elevation (ft amsl) [Z]	Specific Capacity (gpm/ft) [Q/s]	Pumping Rate (gpm) [Q]	Drawdown (ft) [s]	GW Supply Depletion Water Level Threshold (ft amsl) [Z + s + 40 ft]
02N22W09K04S	Hueneme	-103.53	83	2000	24.10	-39.43
02N22W09L03S	Hueneme	-206.94	83	2000	24.10	-142.85
02N22W09L04S	Hueneme	-206.94	83	2000	24.10	-142.85
02N22W10N03S	Hueneme	-45.02	83	2000	24.10	19.08
02N22W16K01S	Hueneme	-162.35	83	2000	24.10	-98.25
02N22W17Q05S	Hueneme	-269.52	83	2000	24.10	-205.42
02N22W07M01S	Hueneme	-1041.36	83	2000	24.10	-977.27
02N22W17M02S	Hueneme	-345.08	83	2000	24.10	-280.99
02N22W20E01S	Hueneme	-273.97	83	2000	24.10	-209.87
02N23W13K03S	Hueneme	-711.48	83	2000	24.10	-647.39
02N23W13K04S	Hueneme	-703.22	83	2000	24.10	-639.12
02N23W15J01S	Hueneme	-824.31	83	2000	24.10	-760.21
02N23W24G01S	Hueneme	-552.57	83	2000	24.10	-488.48
02N22W08G01S	Mugu	-107.88	60	2000	33.33	-34.55
02N22W08P01S	Mugu	-57.21	60	2000	33.33	16.12
02N22W07M02S	Mugu	-414.68	60	2000	33.33	-341.34
02N22W07P01S	Mugu	-262.96	60	2000	33.33	-189.62
02N22W19M04S	Mugu	-212.99	60	2000	33.33	-139.66
02N23W15J02S	Mugu	-454.22	60	2000	33.33	-380.88

Although this water level threshold calculation was considered for the minimum threshold for the chronic lowering of groundwater levels sustainability indicator, it was noted that some calculated levels are several hundred feet lower in elevation than the measured historical low groundwater elevation (especially for the Hueneme aquifer), while others are similar into the historical low elevations; this is due to the significant folding of the principal aquifers that create a variable depth to the top of aquifer throughout the Basin. Other considerations include the prevention of land subsidence, avoiding potentially unrecoverable reduction of groundwater storage, and impacting underflows to/from the adjacent Oxnard Basin. After considering these factors, therefore, the minimum thresholds for the chronic lowering of groundwater levels are conservatively set at the historical low groundwater elevations in the monitoring wells. This approach will protect the wells near anticlines (upward folds), prevent land subsidence, prevent the Basin groundwater levels from falling beyond a point from which groundwater storage may not fully recover, and ensure that underflow to/from the Oxnard Basin is not unduly impacted to ensure the protection of the overall groundwater supply for the Basin (i.e., groundwater levels going significantly below historical lows could lead to long-term storage depletions). However, as discussed in Section 4.4.2.1.1 of the GSP, some of the minimum thresholds that fall below the historical low groundwater levels are superseded by the proxy groundwater level minimum thresholds for the land subsidence sustainability indicator. The resulting minimum thresholds are depicted on the time-series plots (hydrographs) below.

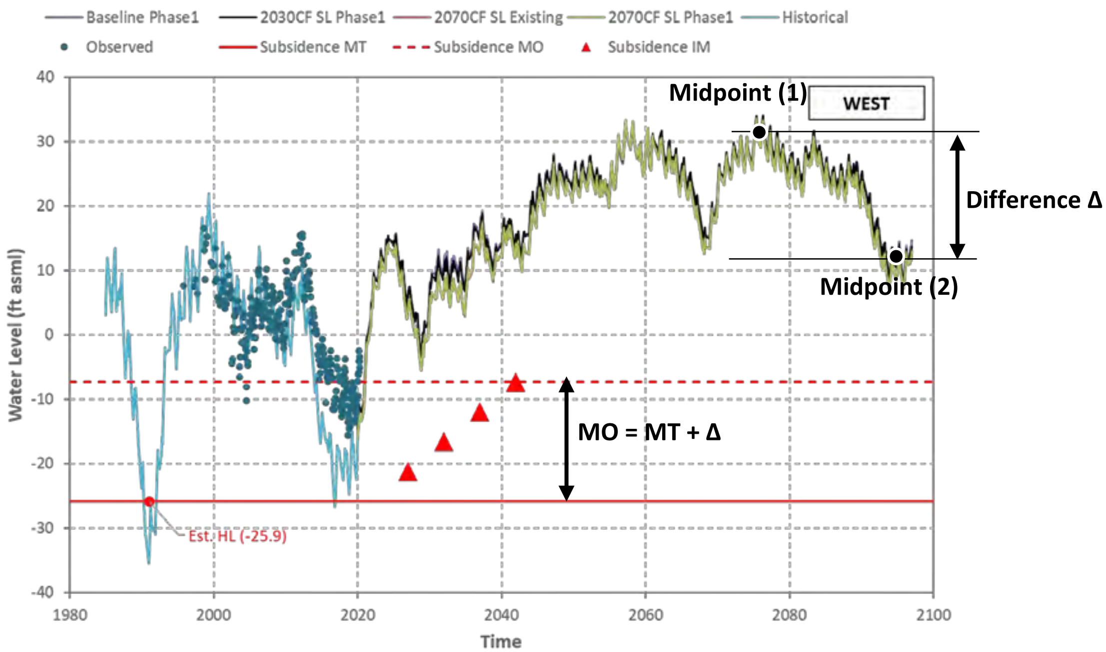
Land Subsidence MT:
For the wells in the eastern half of the Basin, a subsidence rate of ≥ 0.1 ft/year (based on corrected measurements calculated from InSAR data) was used as the MT for when the GWL is at or below the HL. For the wells in the western half of the Basin, the HL was used as the MT.

Measurable Objectives (MO) and Interim Milestones (IM)

The MO was estimated as follows:

(1) The upper limit of the GWL range in the baseline projected model results was extracted by locating the midpoint between the highest and lowest simulated in the 2074 – 2076 period (the highest modeled GWLs).
(2) The lower limit of the GWL range in the baseline projected model results was extracted by locating the midpoint between the highest and lowest simulated GWL in the 2093 – 2095 period (the lowest modeled GWLs following the highest modeled GWLs).
(3) The difference between the two midpoints from (1) and (2) was added to the MT. This difference represents the maximum modeled decline in GWL at the well location.

The IM was estimated by calculating the difference between MT and MO and dividing that range into four sections. Starting from year 2022, IM was set for 2027, 2032, 2037, and 2042 (20 years).


Baseline Phase1
2030CF SL Phase1
2070CF SL Existing
2070CF SL Phase1
Historical
Observed
Subsidence MT
Subsidence MO
Subsidence IM
Midpoint (1)
WEST
Difference Δ
Midpoint (2)
MO = MT + Δ
Est. HL (-25.9)
Water Level (ft asml)
Time

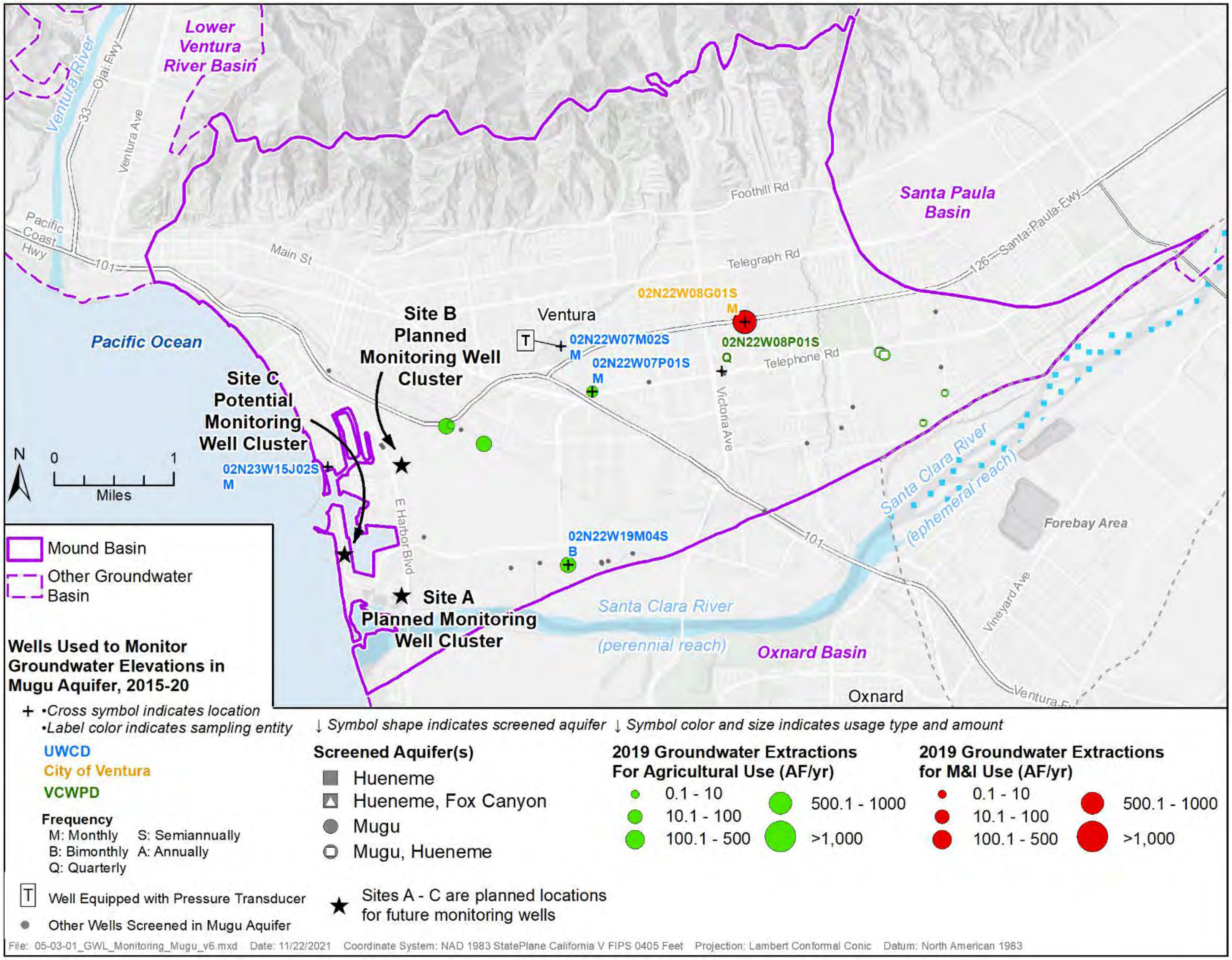


Figure I-1 Map Showing the Groundwater Elevation Monitoring Network in the Mugu Aquifer of Mound Basin.

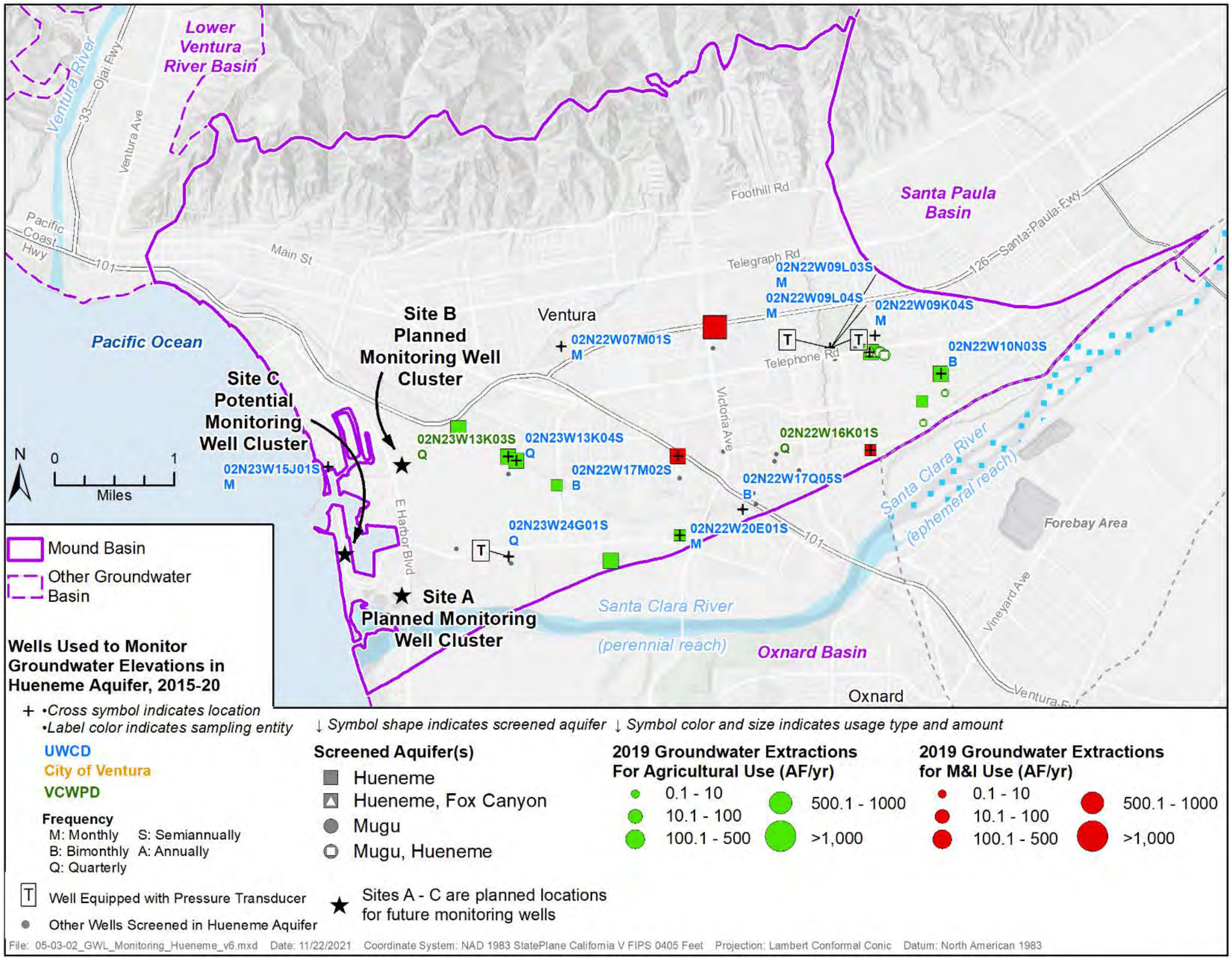


Figure I-2 Map Showing the Groundwater Elevation Monitoring Network in the Hueneme Aquifer of Mound Basin Aquifer of Mound Basin.

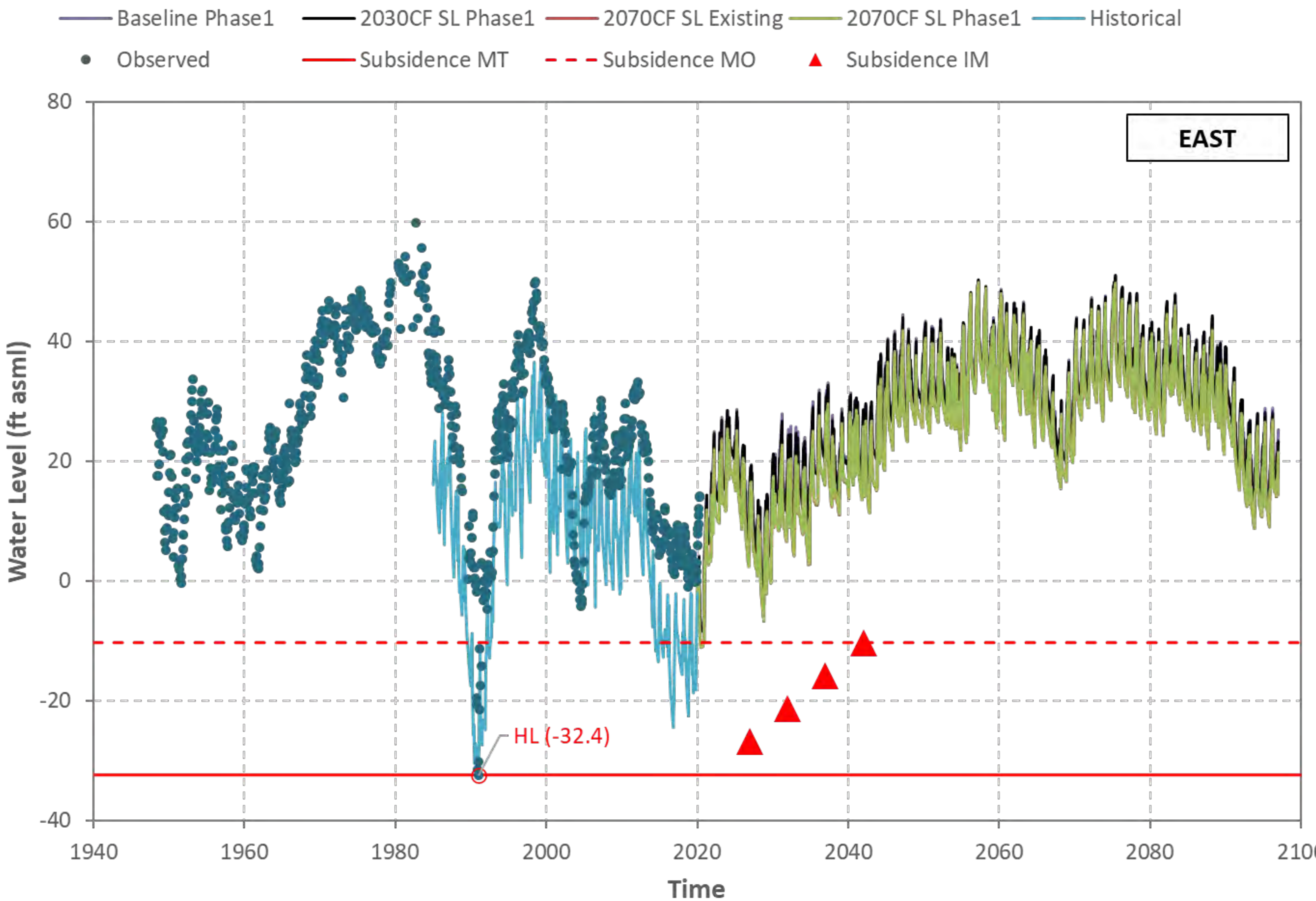


Figure I-3 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W09K04S).

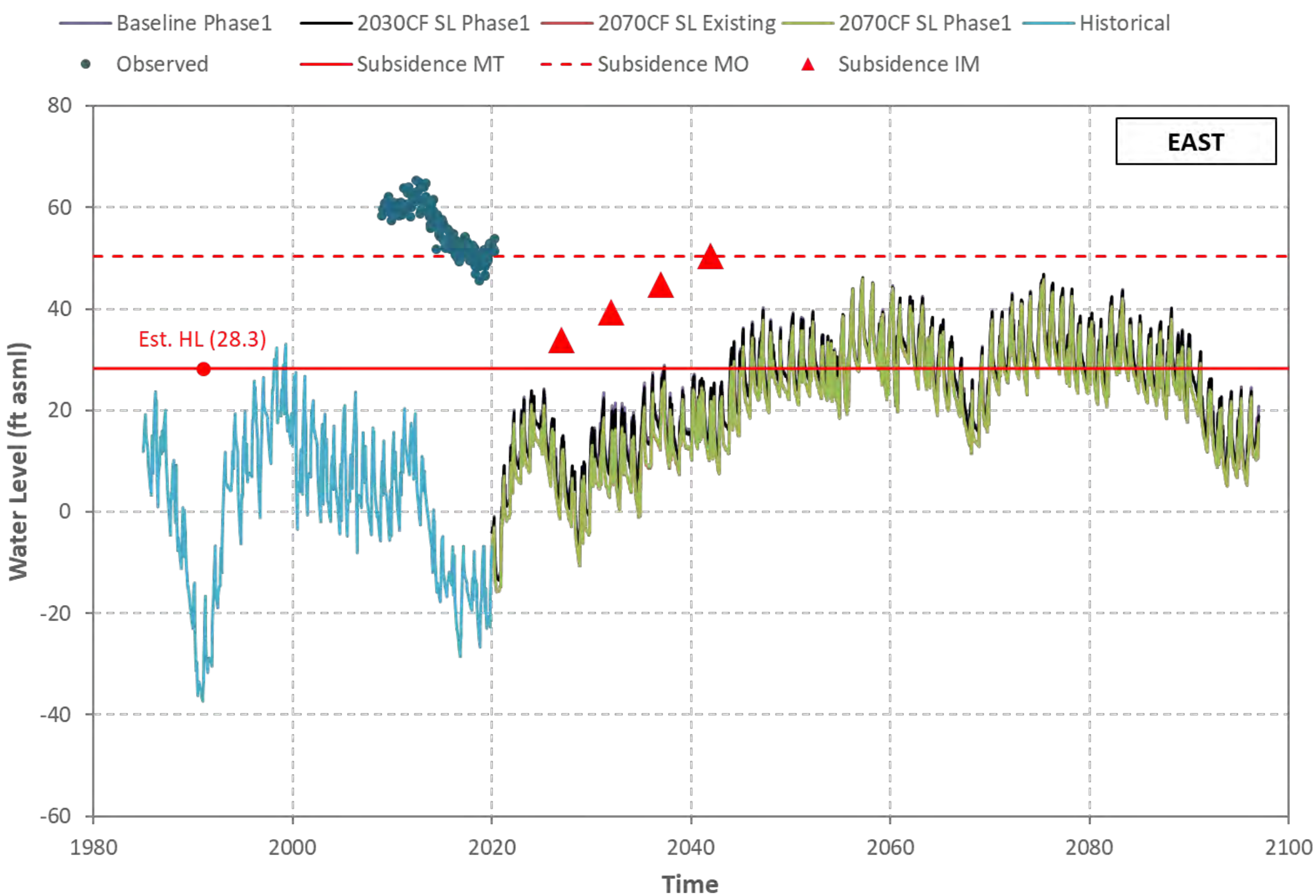


Figure I-4 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W09L03S).

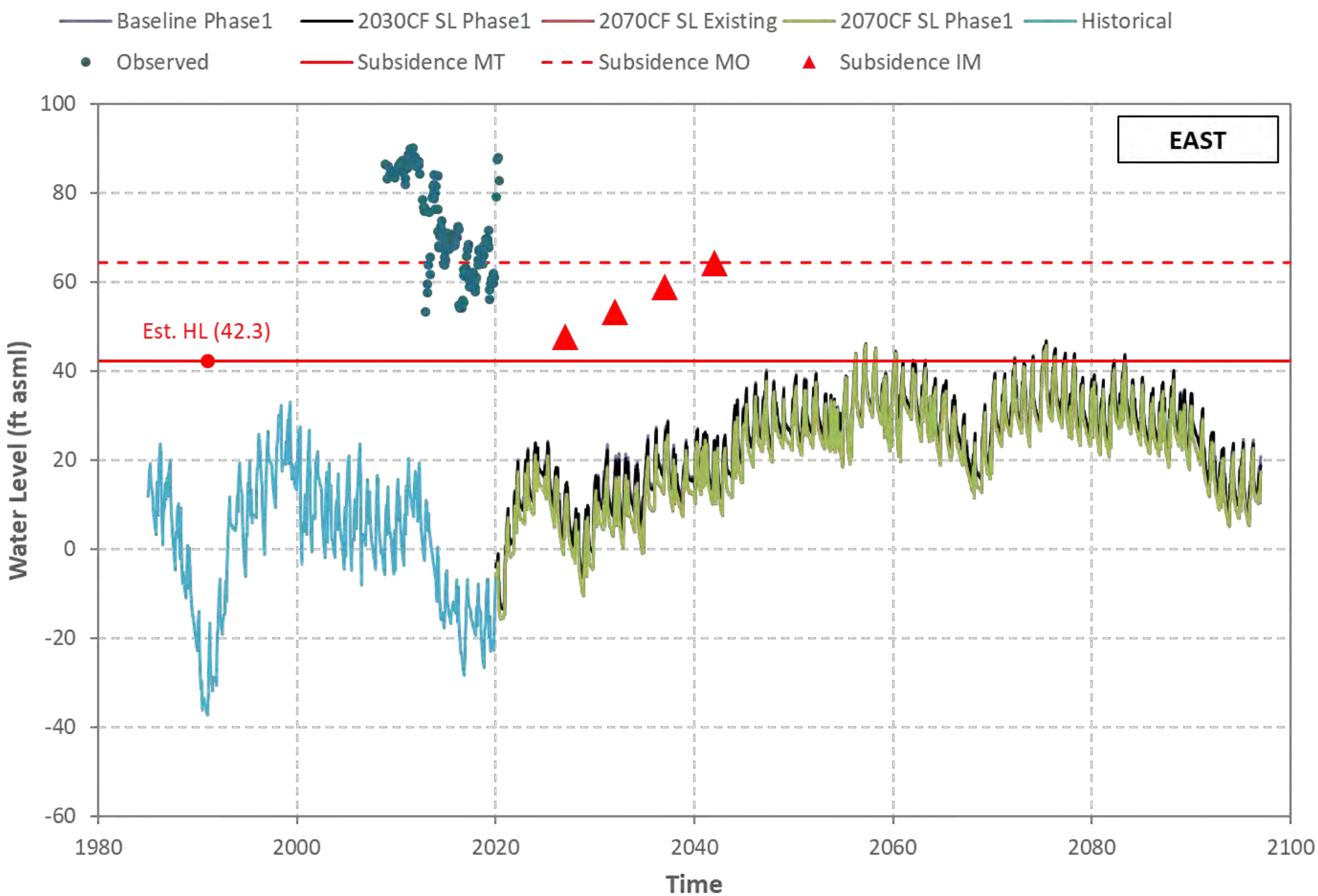


Figure I-5 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W09L04S).

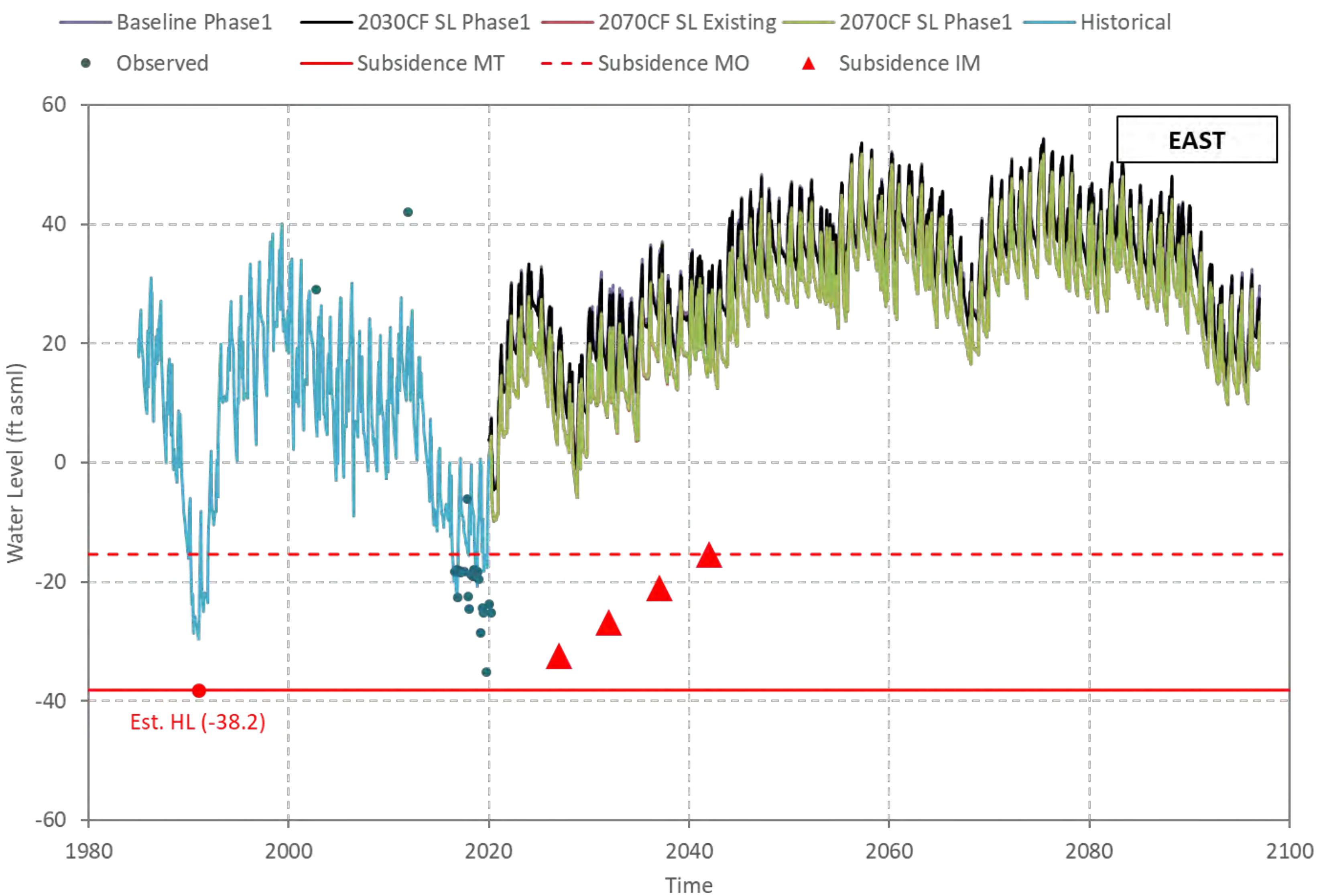


Figure I-6 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W10N03S).

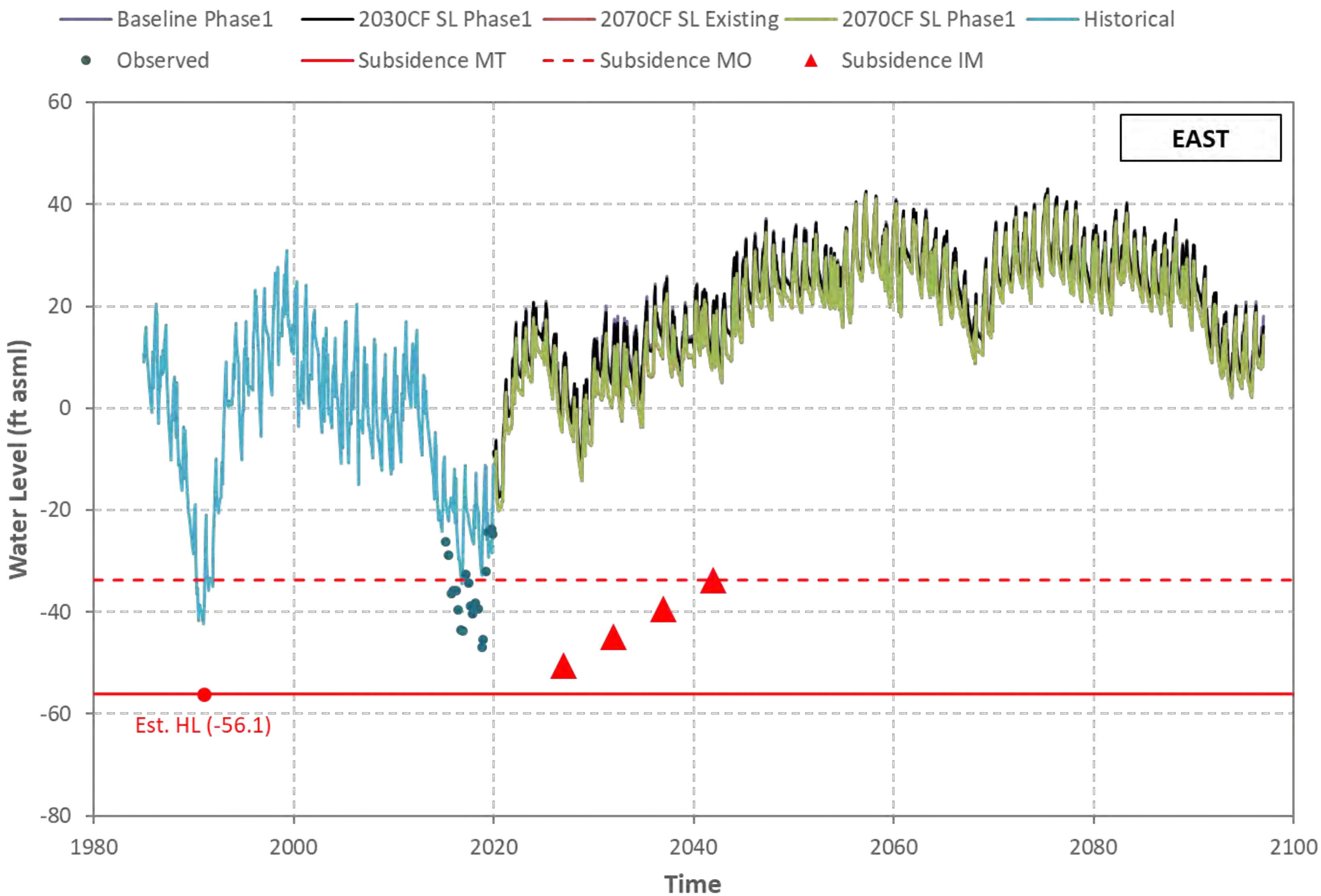


Figure I-7 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W16K01S).

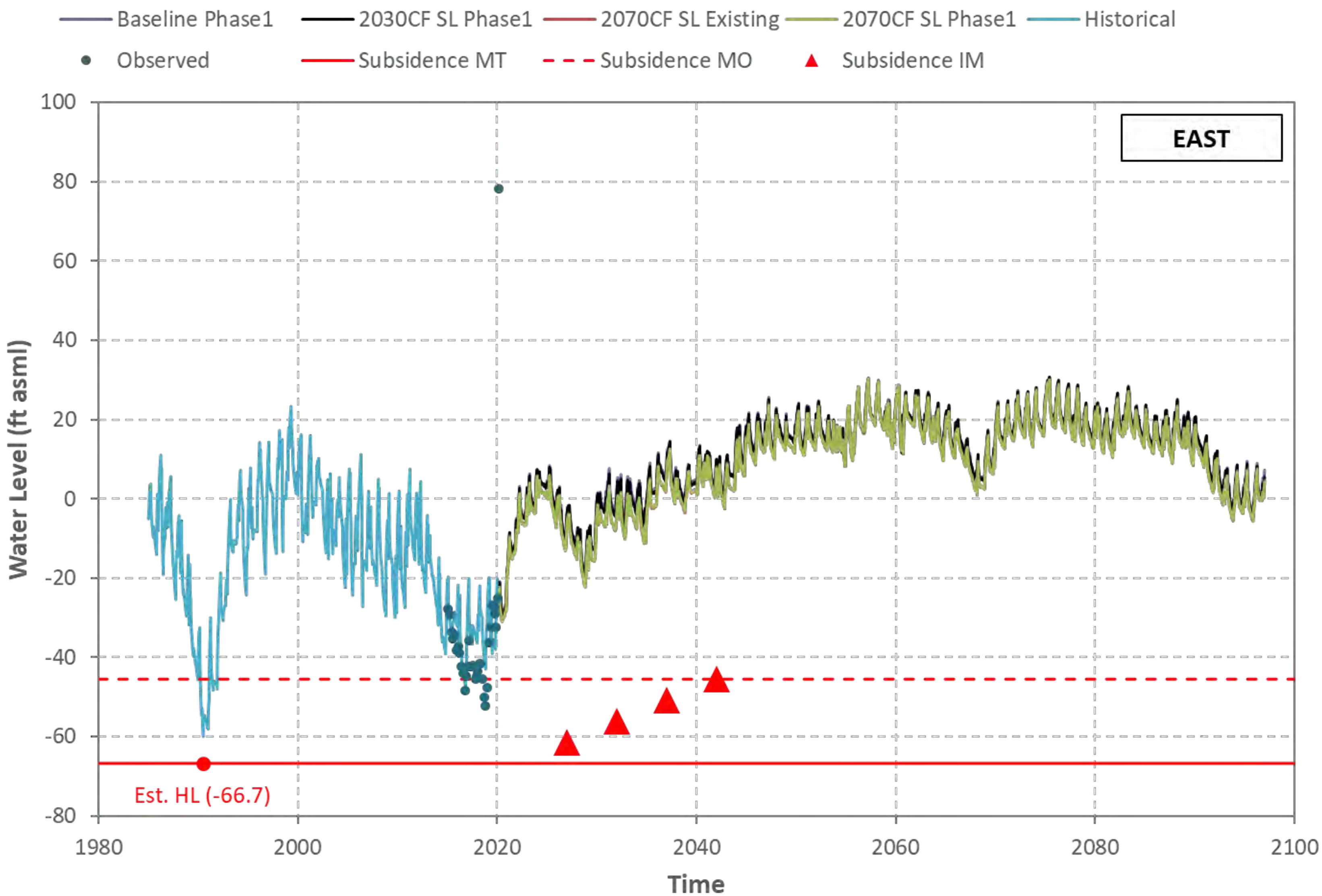


Figure I-8 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W17Q05S).

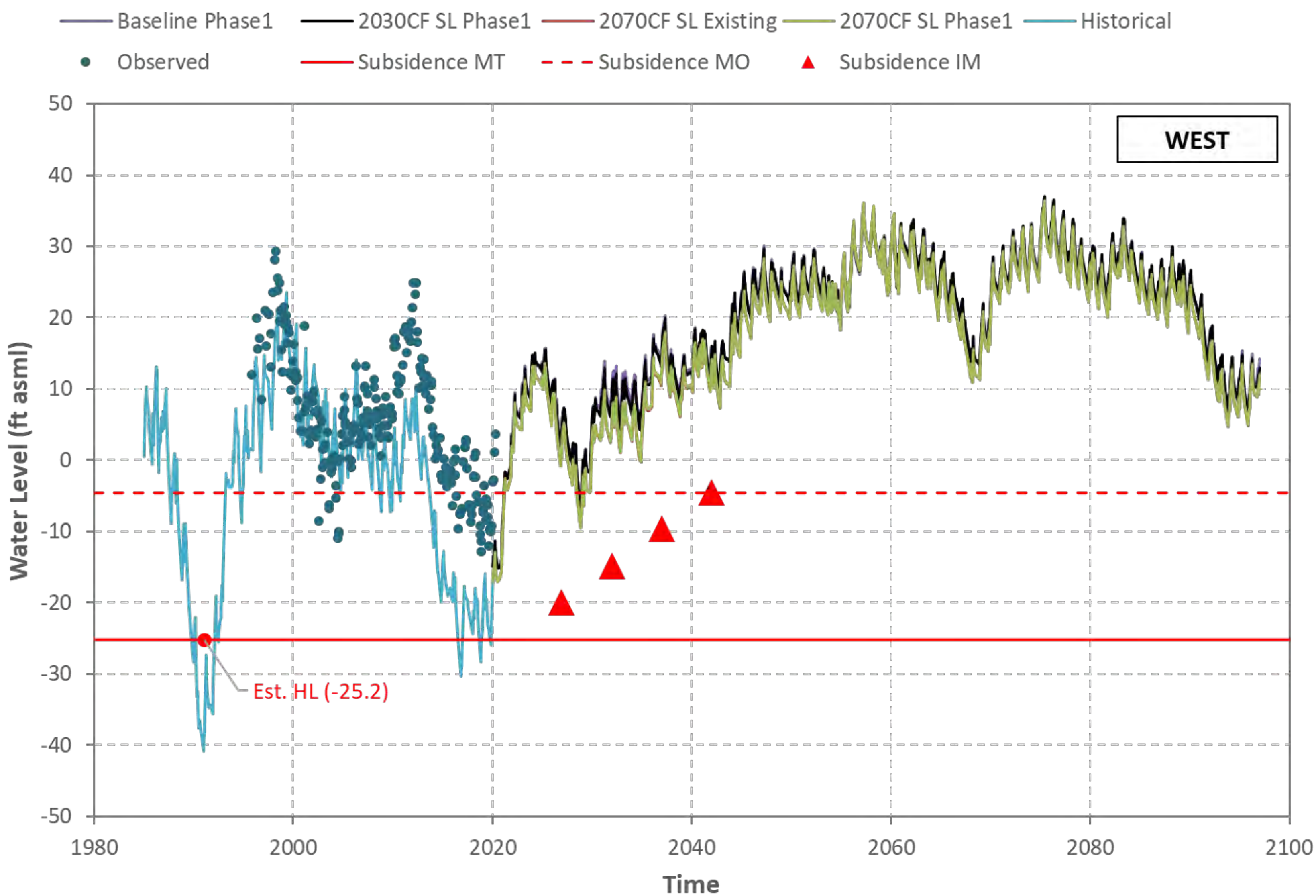


Figure I-9 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W07M01S).

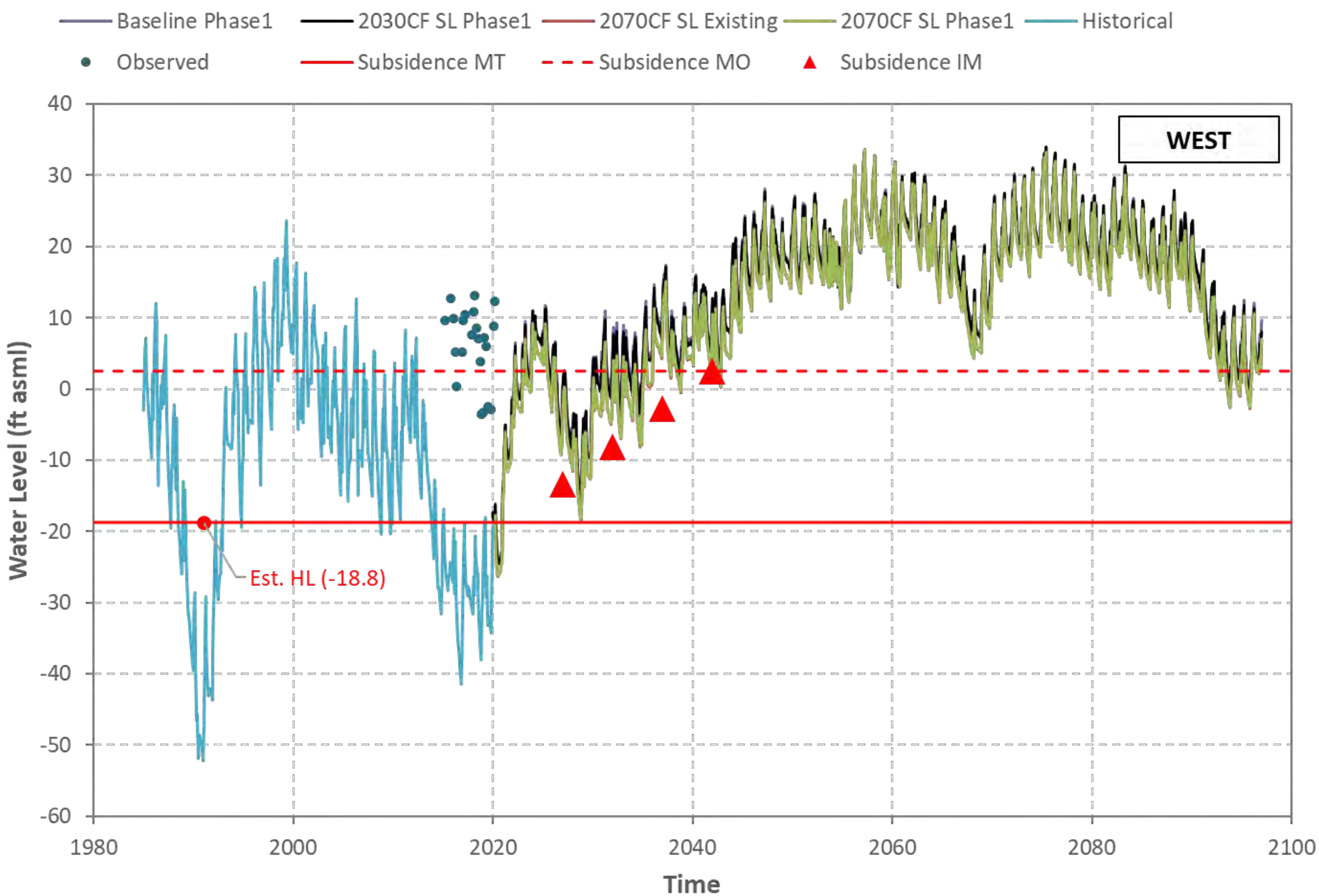


Figure I-10 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W17M02S).

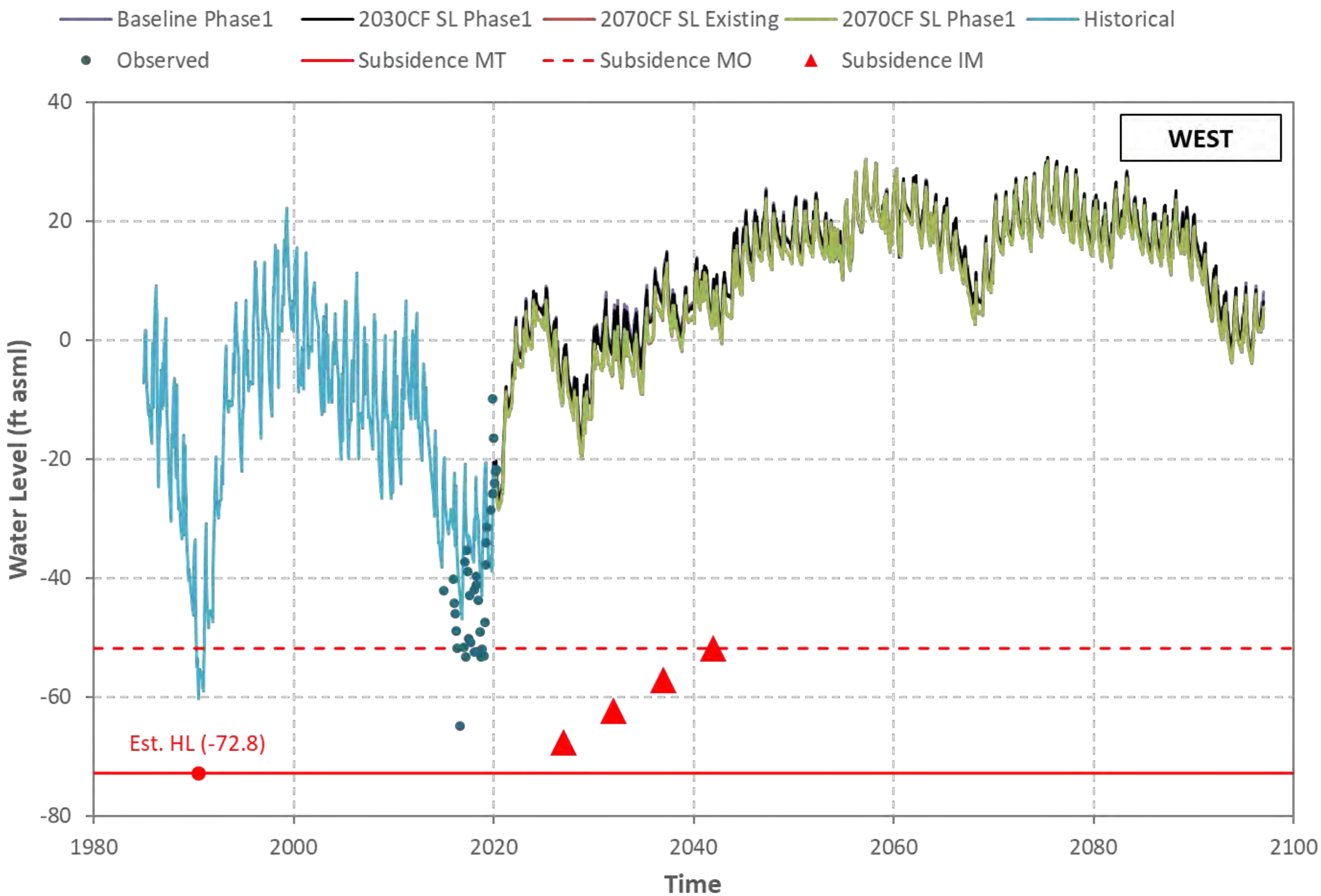


Figure I-11 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N22W20E01S).

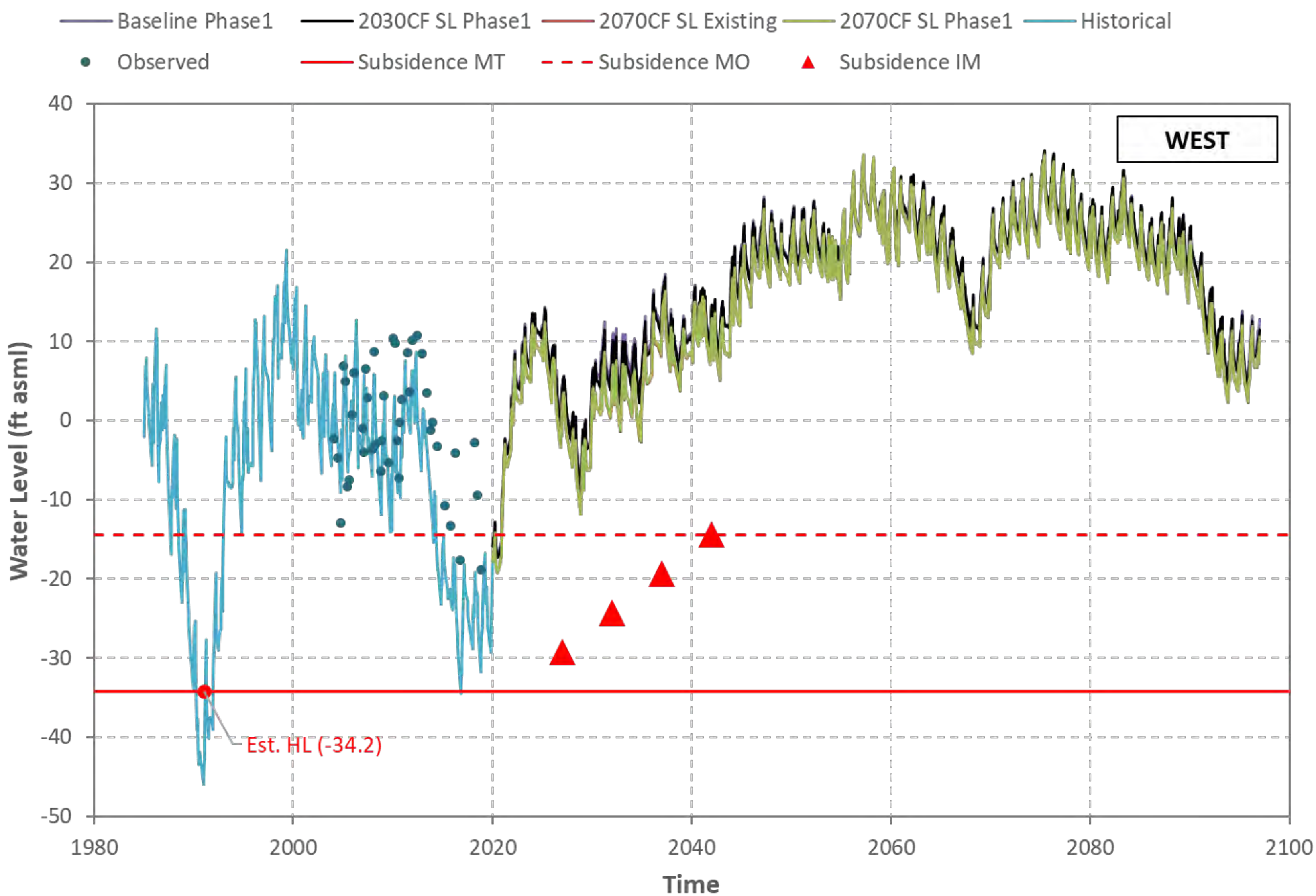


Figure I-12 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N23W13K03S).

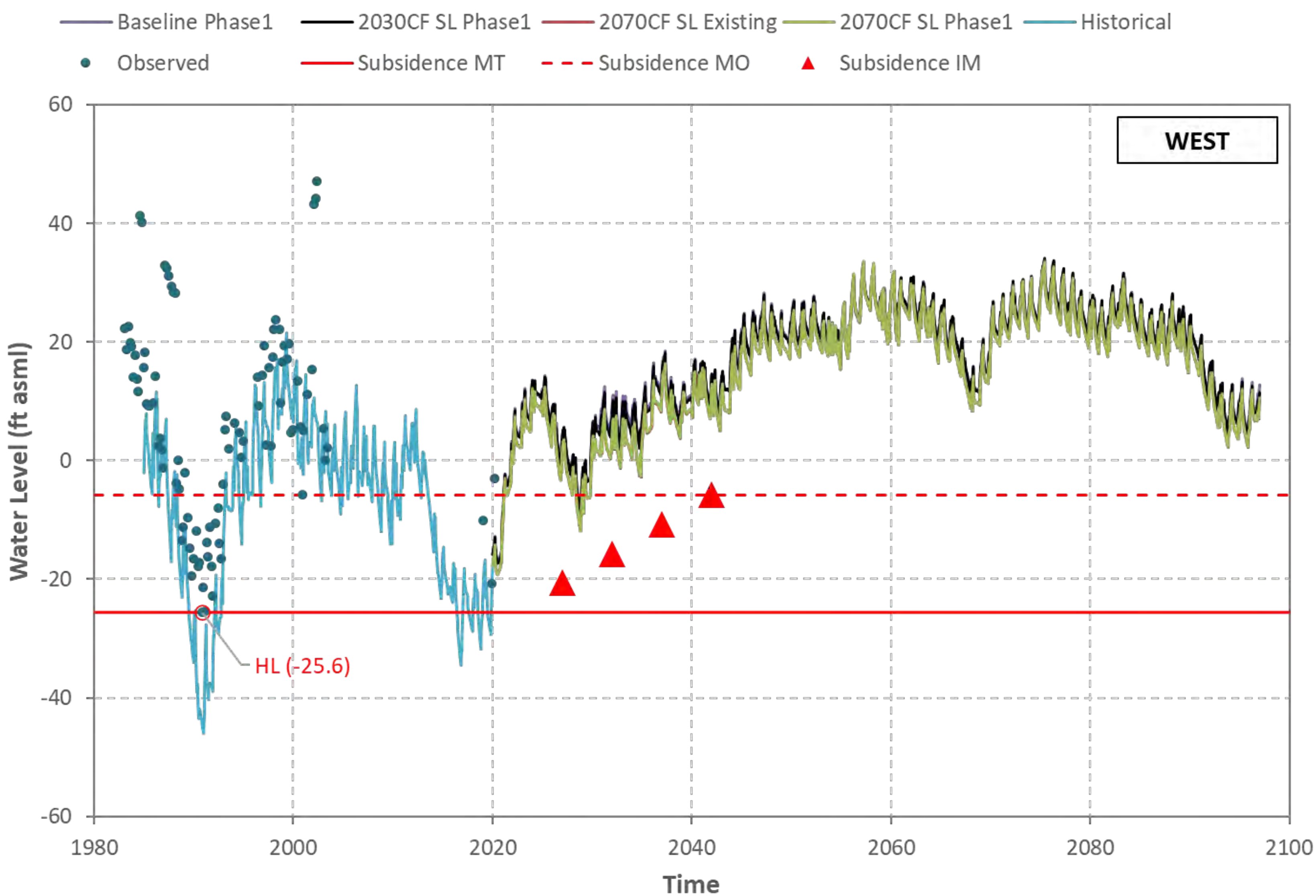


Figure I-13 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N23W13K04S).

Figure I-14 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N23W15J01S).

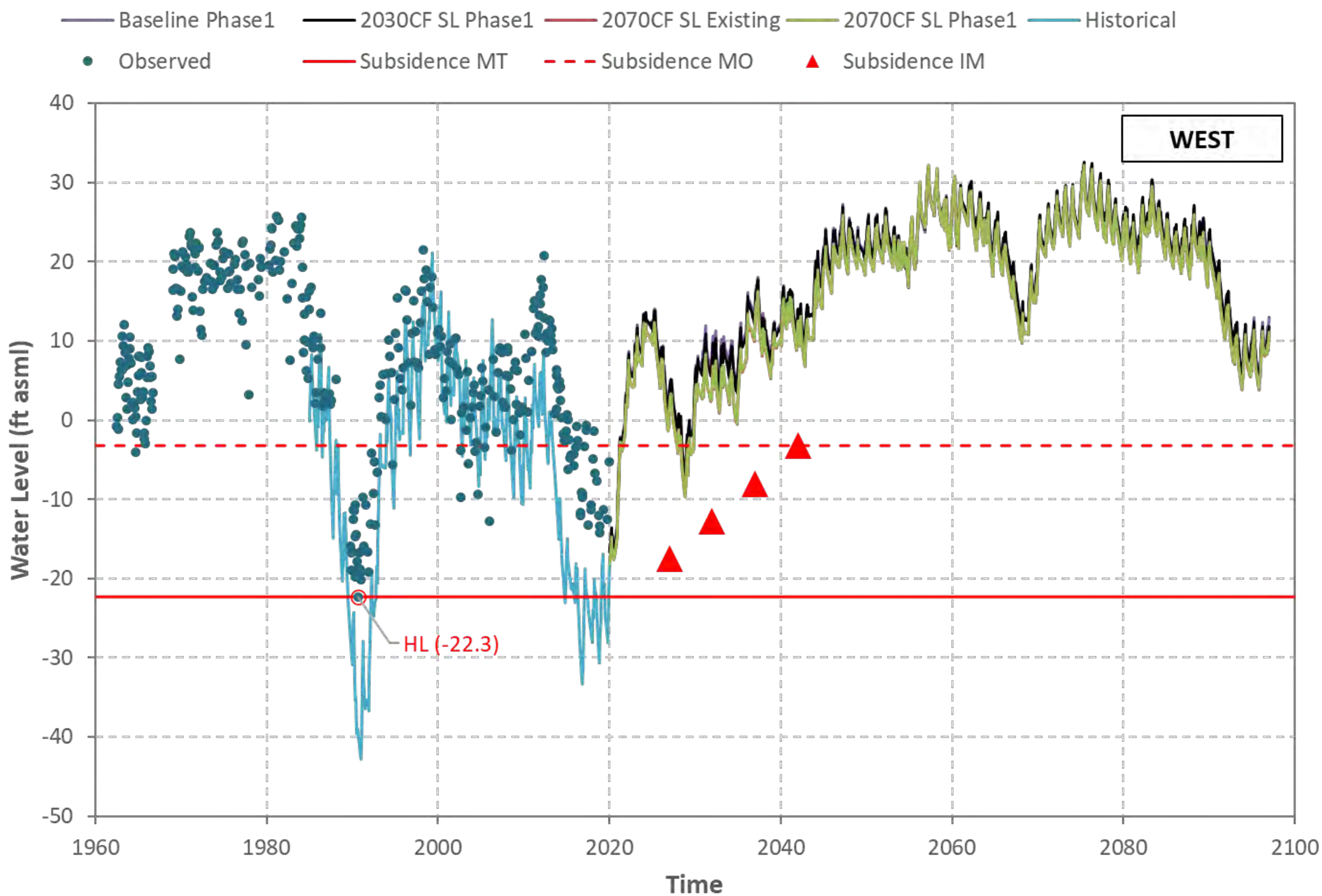


Figure I-15 Hueneme Aquifer - Simulated/Observed Water Level (Well 02N23W24G01S).

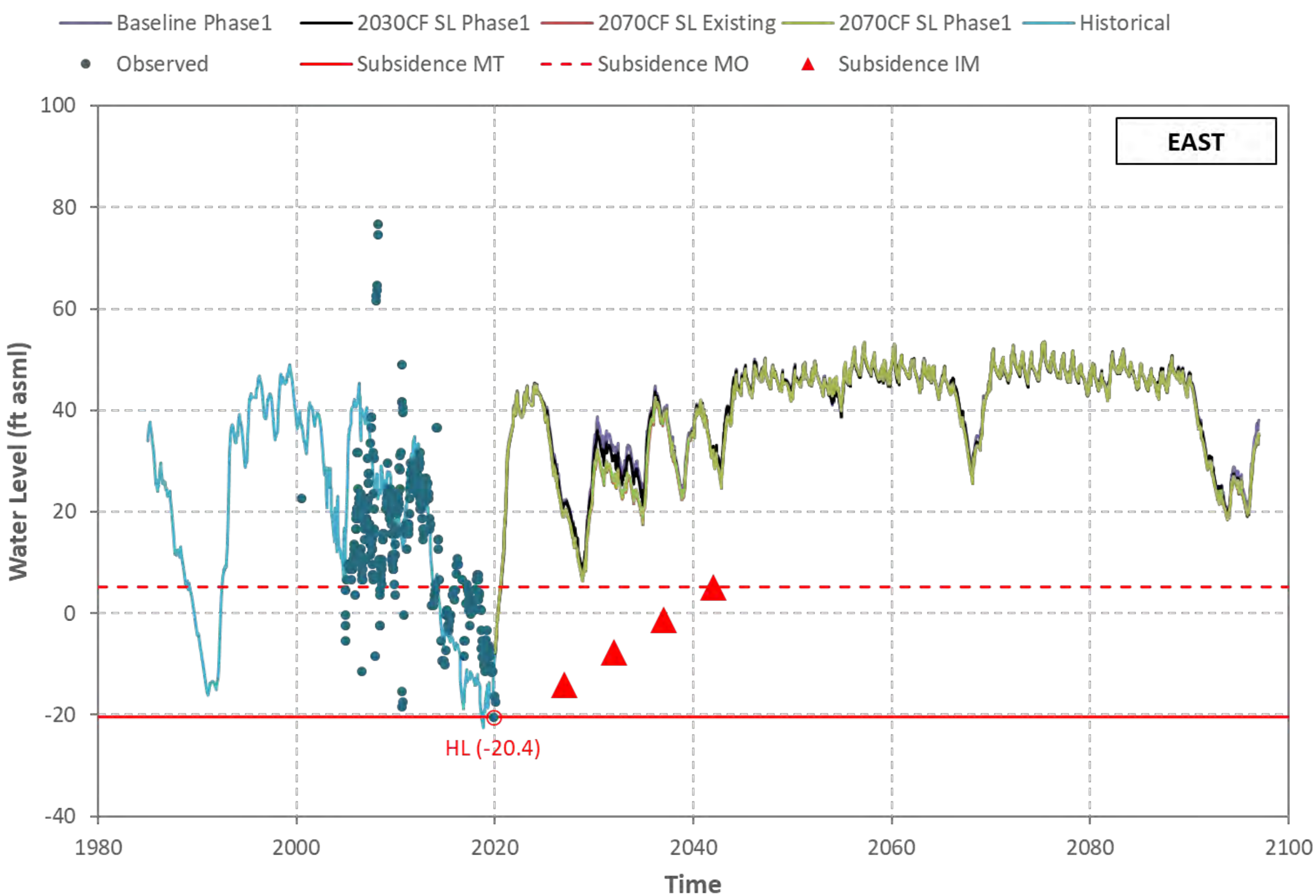


Figure I-16 Mugu Aquifer - Simulated/Observed Water Level (Well 02N22W08G01S).

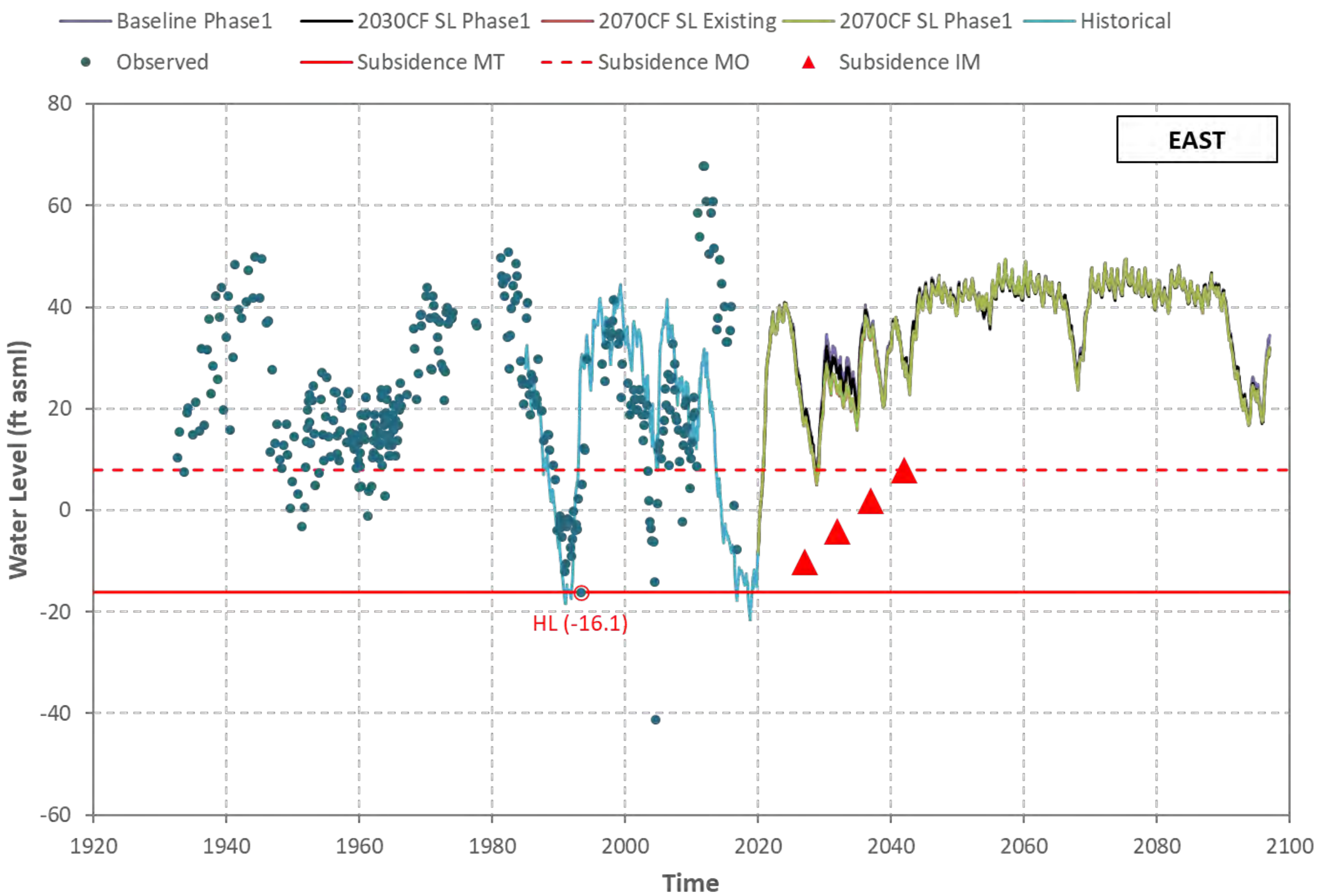


Figure I-17 Mugu Aquifer - Simulated/Observed Water Level (Well 02N22W08P01S).

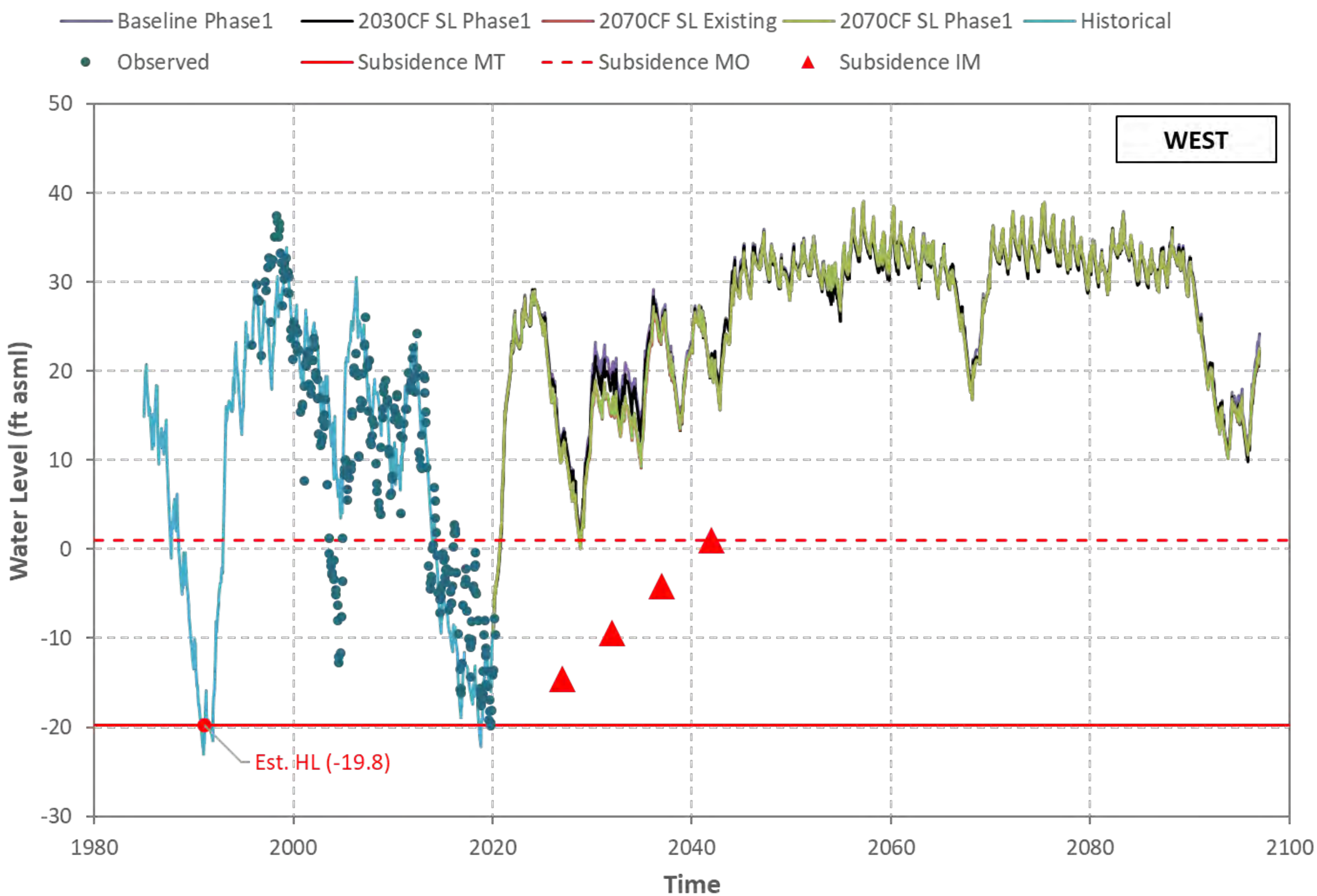


Figure I-18 Mugu Aquifer - Simulated/Observed Water Level (Well 02N22W07M02S).

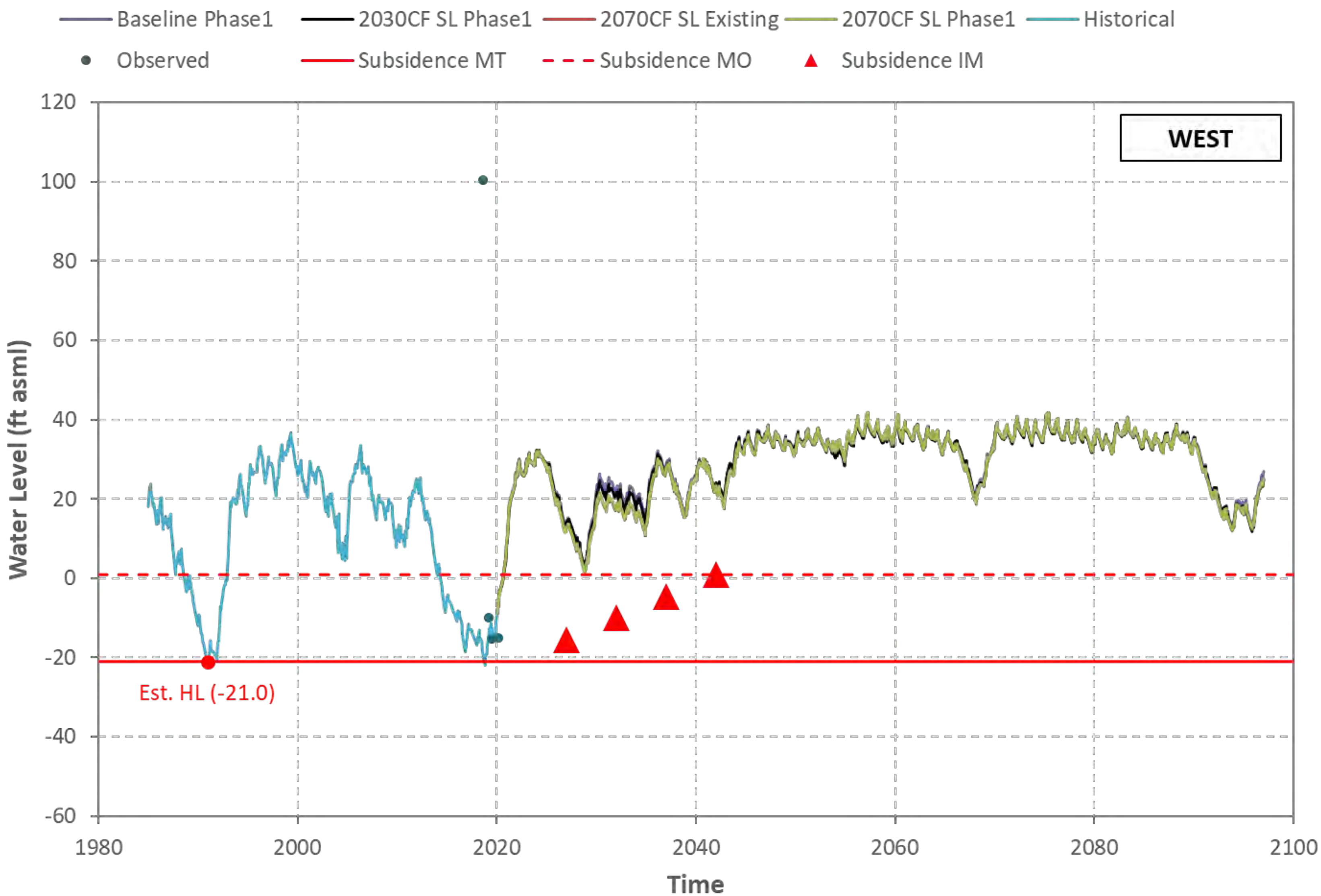


Figure I-19 Mugu Aquifer - Simulated/Observed Water Level (Well 02N22W07P01S).

Figure I-20 Mugu Aquifer - Simulated/Observed Water Level (Well 02N22W19M04S).

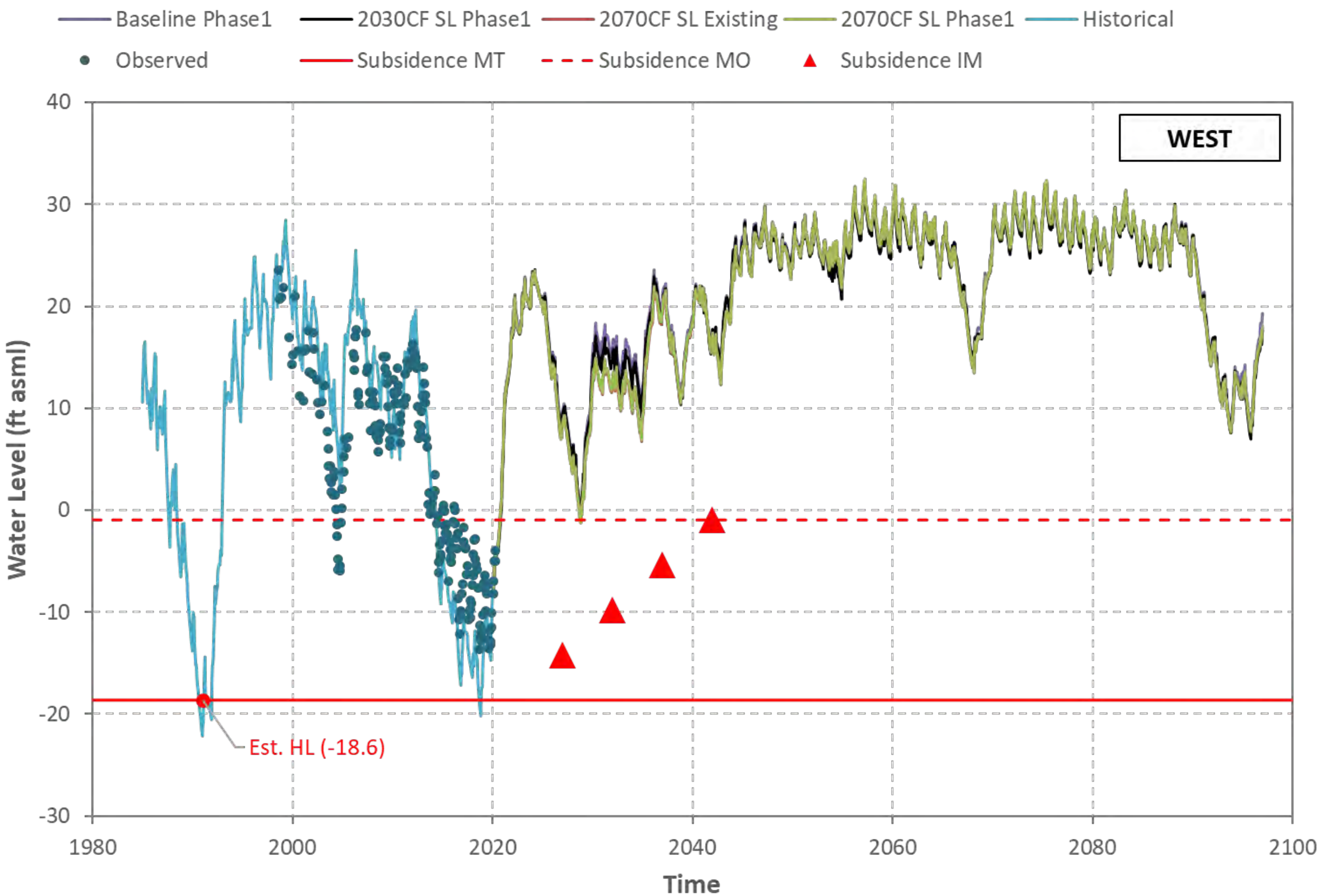


Figure I-21 Mugu Aquifer - Simulated/Observed Water Level (Well 02N23W15J02S).

Appendix J

Time Series Plots of Groundwater Quality with Minimum Thresholds and Measurable Objectives

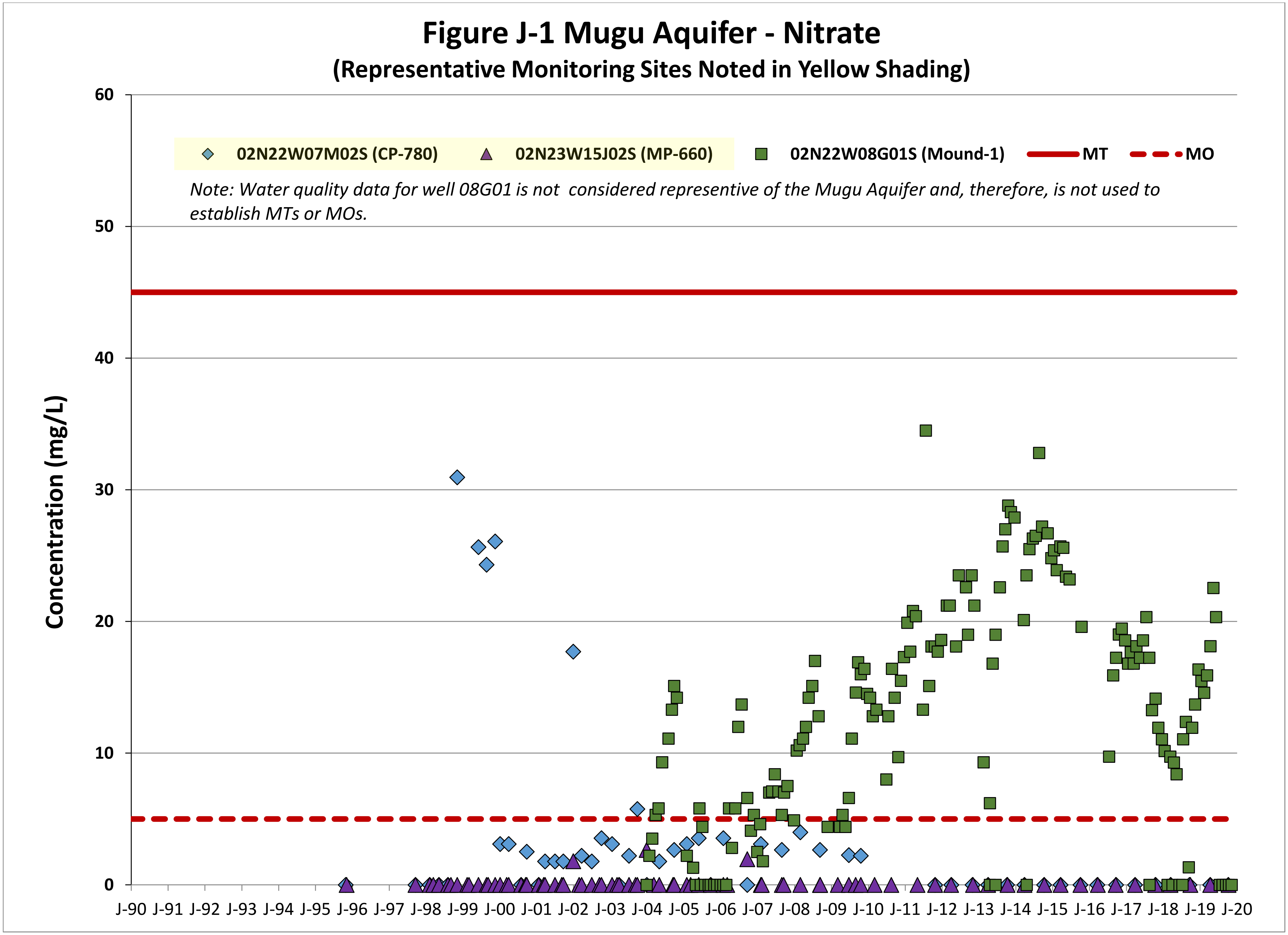


Figure J-1 Mugu Aquifer - Nitrate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MT
MO
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
0
10
20
30
40
50
60
J-90
J-91
J-92
J-93
J-94
J-95
J-96
J-97
J-98
J-99
J-00
J-01
J-02
J-03
J-04
J-05
J-06
J-07
J-08
J-09
J-10
J-11
J-12
J-13
J-14
J-15
J-16
J-17
J-18
J-19
J-20

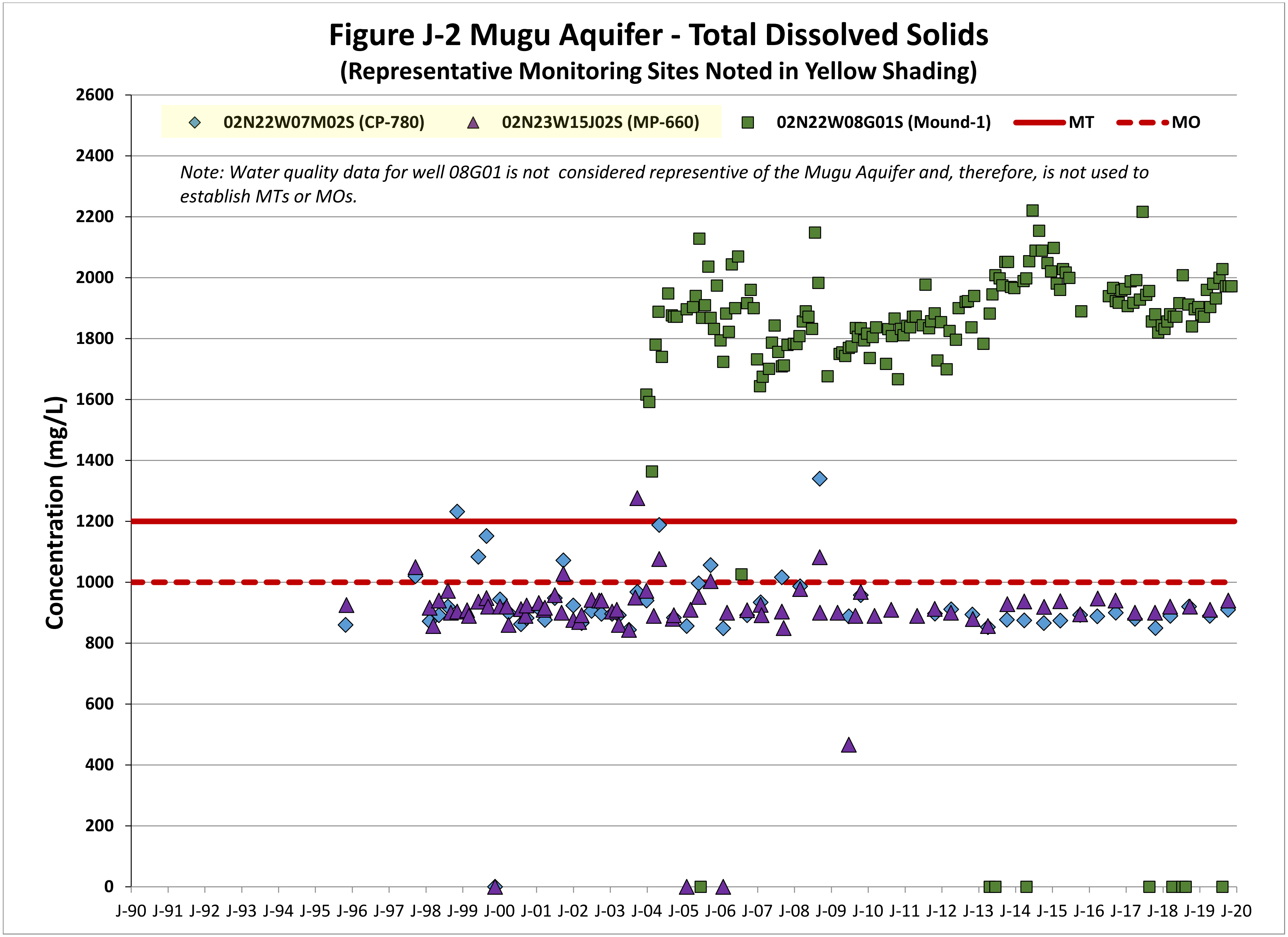


Figure J-2 Mugu Aquifer - Total Dissolved Solids
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MT
MO
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

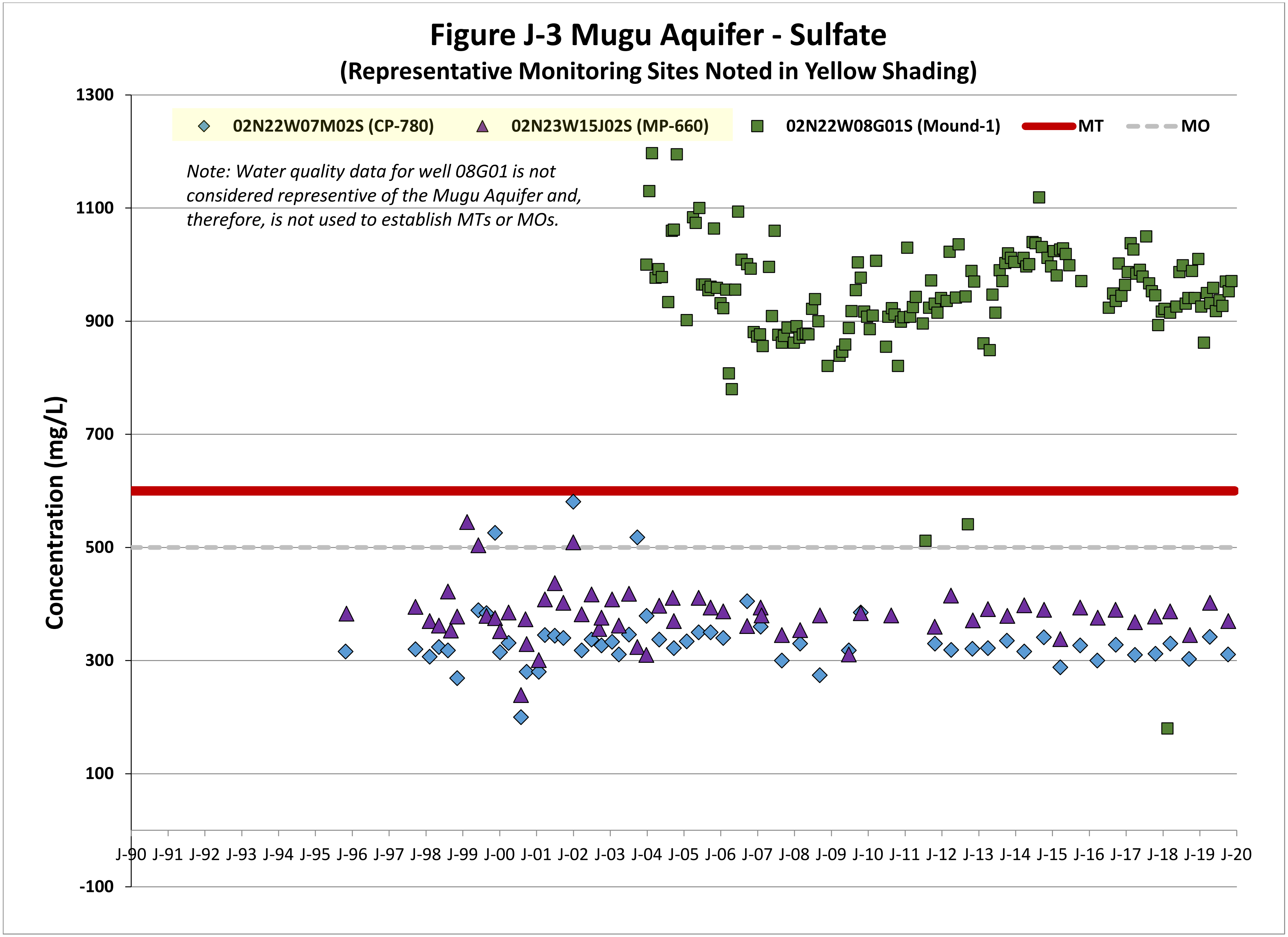


Figure J-3 Mugu Aquifer - Sulfate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MT
MO
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
1300
1100
900
700
500
300
100
-100
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

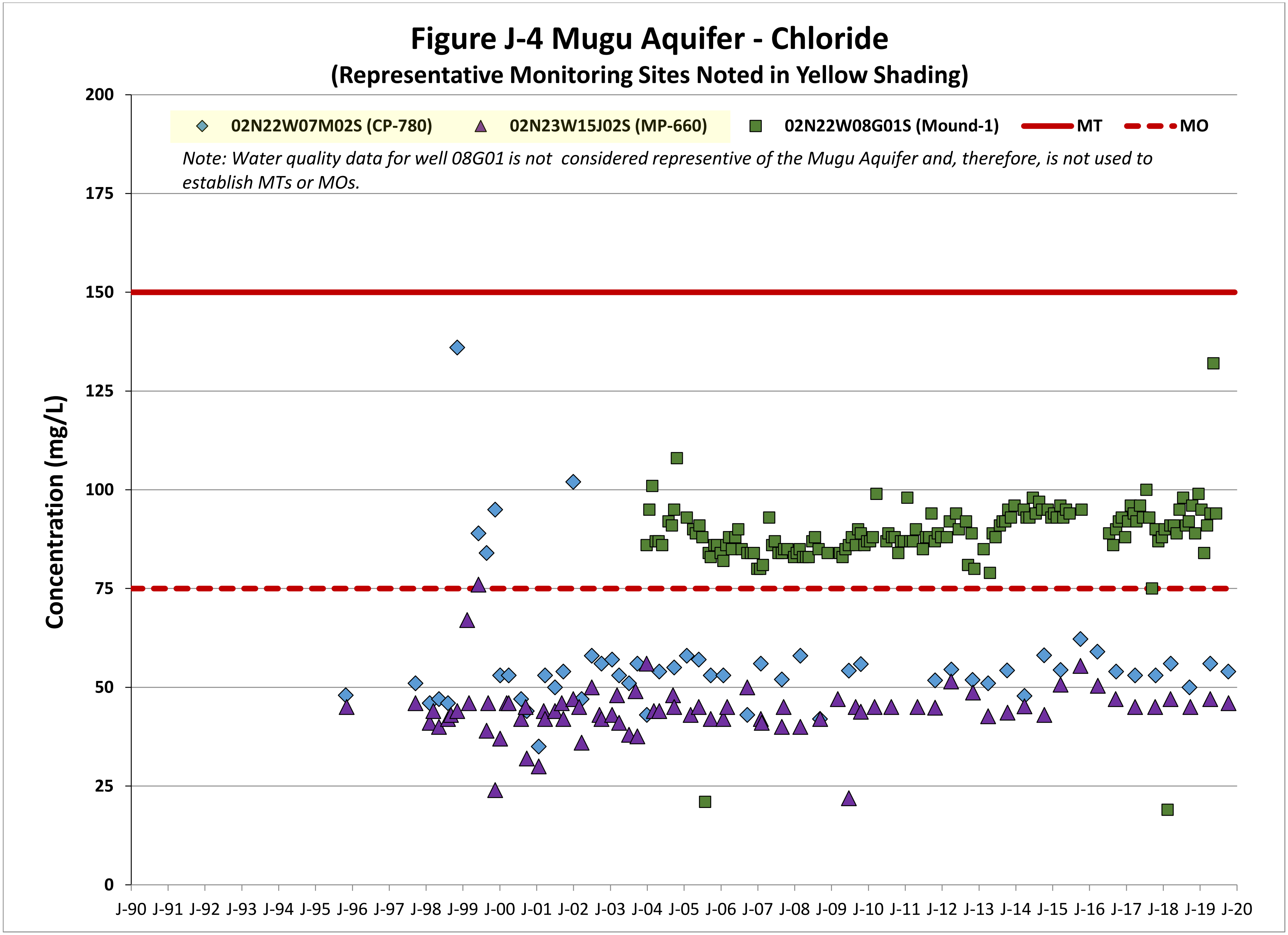


Figure J-4 Mugu Aquifer - Chloride
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MT
MO
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
200
175
150
125
100
75
50
25
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

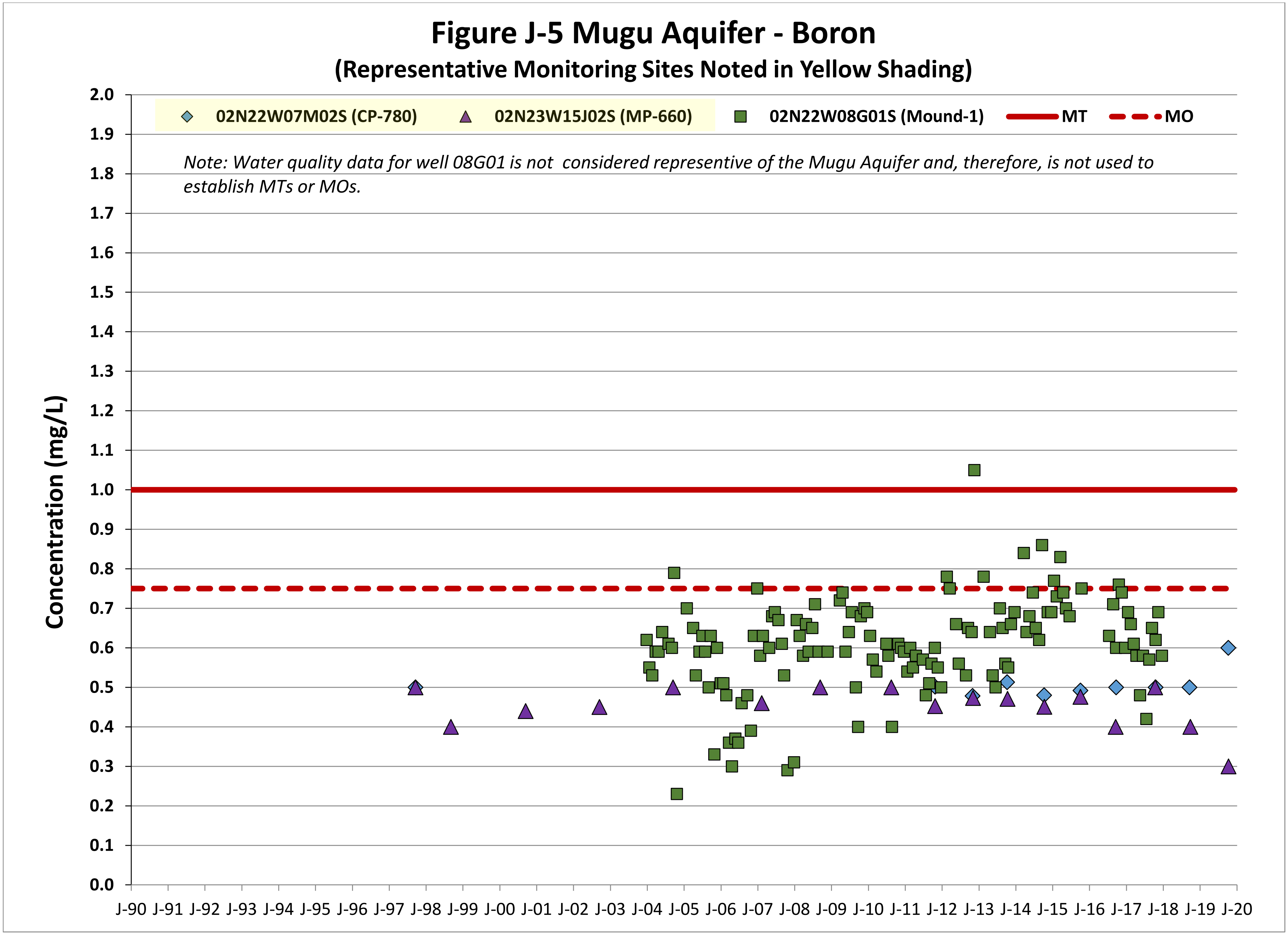


Figure J-5 Mugu Aquifer - Boron
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MT
MO
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

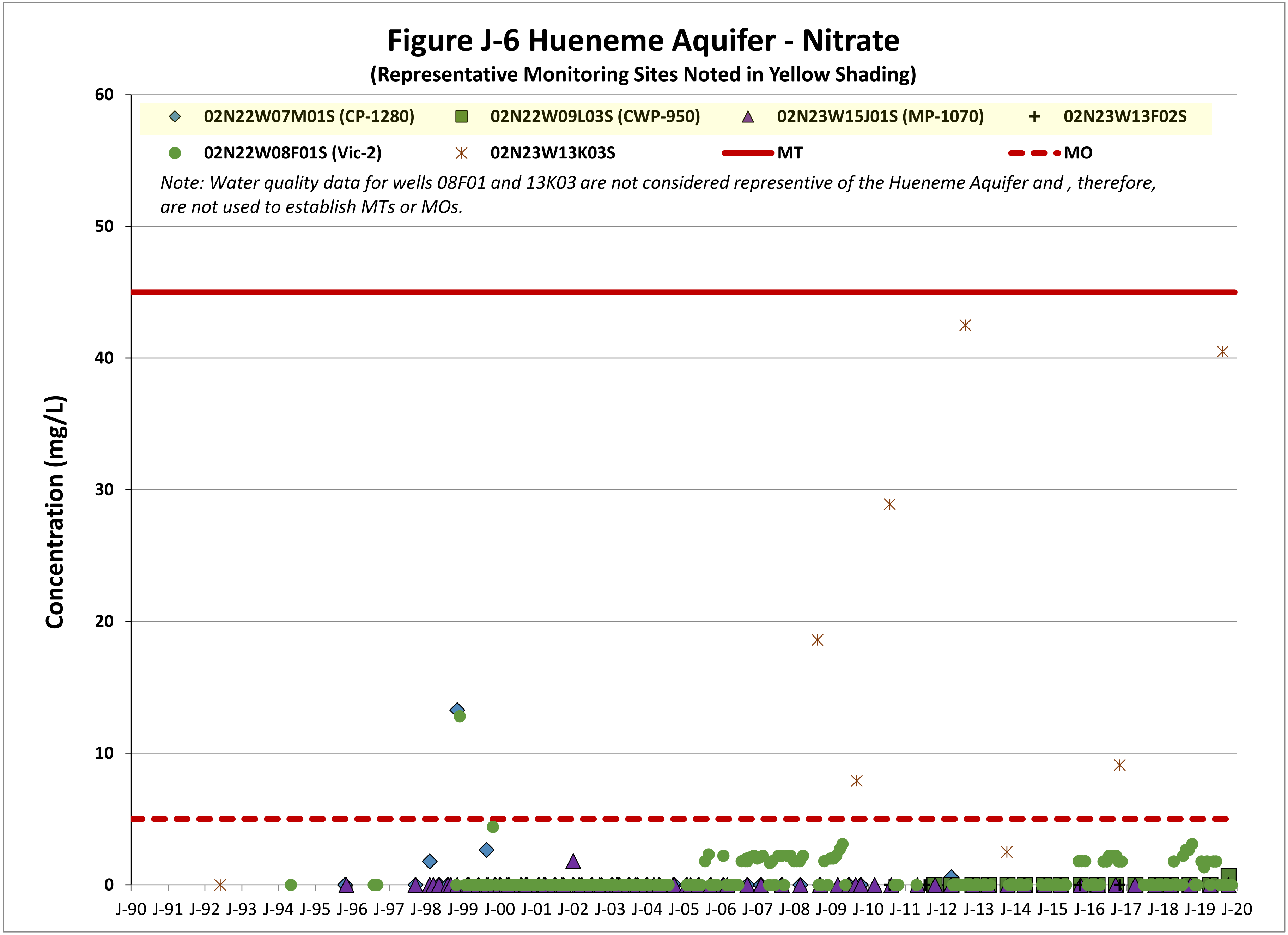


Figure J-6 Hueneme Aquifer - Nitrate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MT
MO
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
60
50
40
30
20
10
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

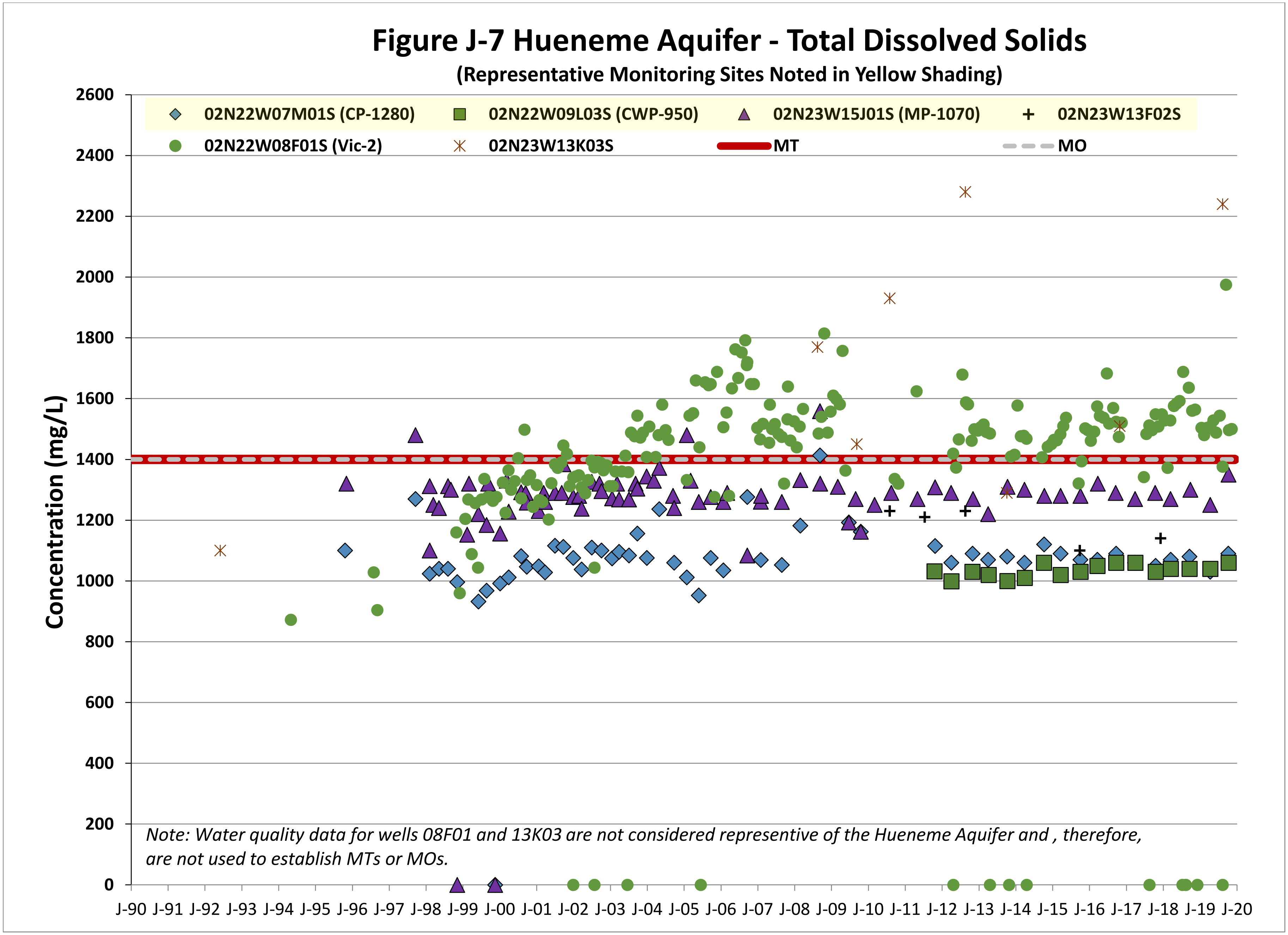


Figure J-7 Hueneme Aquifer - Total Dissolved Solids
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MT
MO
Concentration (mg/L)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20
Note: Water quality data for wells 08F01 and 13K03 are not considered representive of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.

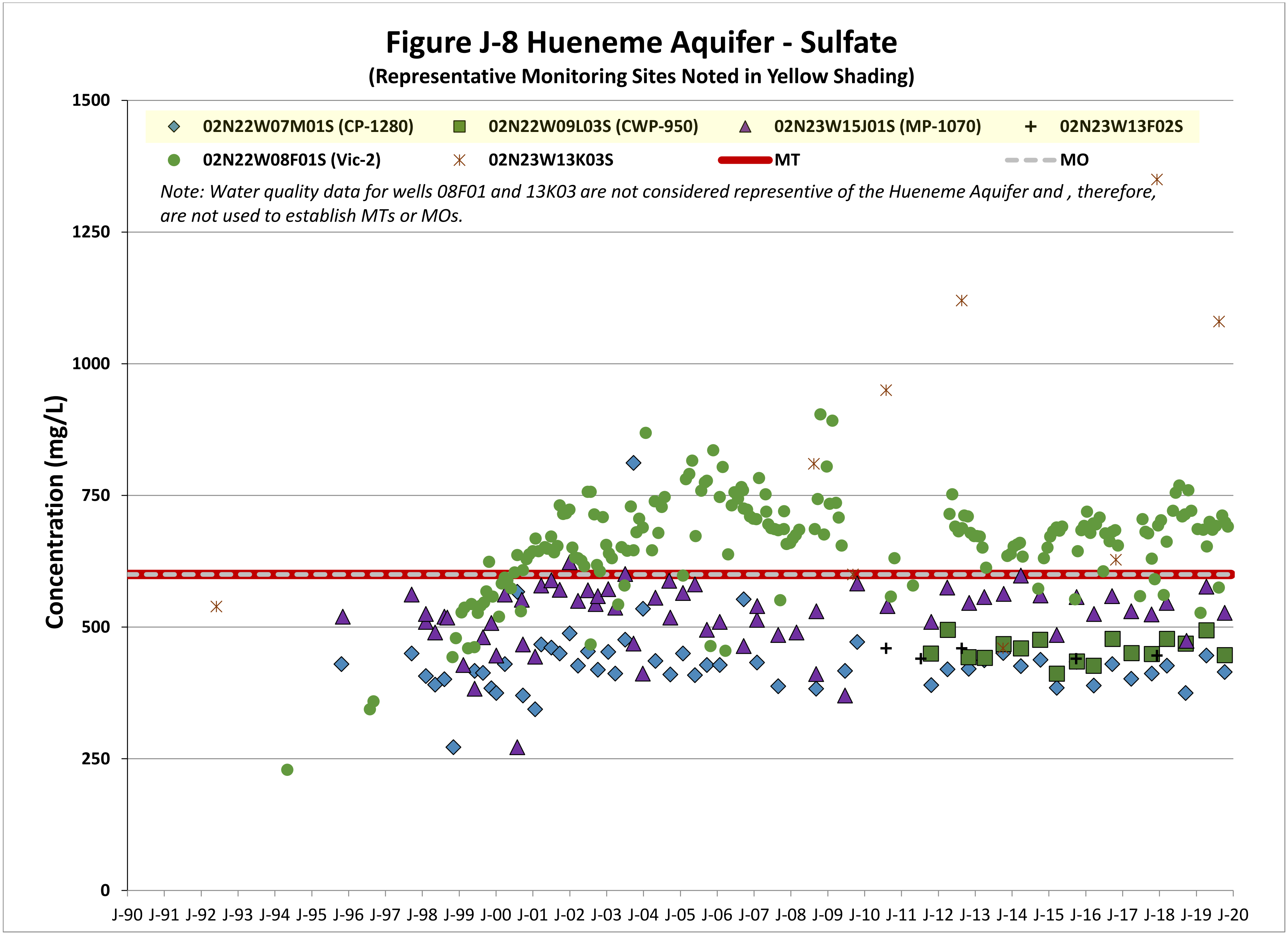


Figure J-8 Hueneme Aquifer - Sulfate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MT
MO
Note: Water quality data for wells 08F01 and 13K03 are not considered representive of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
1500
1250
1000
750
500
250
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

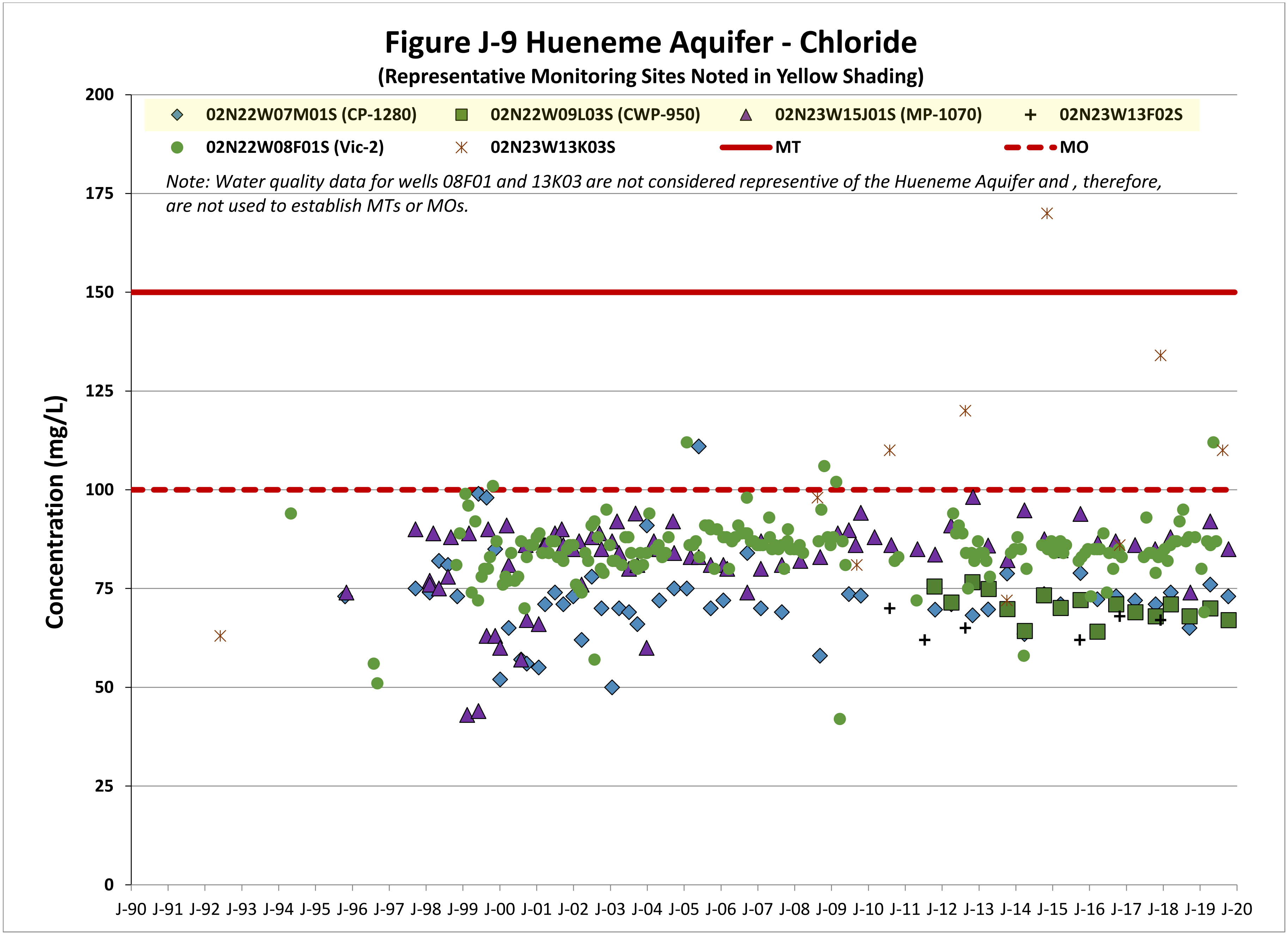


Figure J-9 Hueneme Aquifer - Chloride
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MT
MO
Note: Water quality data for wells 08F01 and 13K03 are not considered representive of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
200
175
150
125
100
75
50
25
0
J-90
J-91
J-92
J-93
J-94
J-95
J-96
J-97
J-98
J-99
J-00
J-01
J-02
J-03
J-04
J-05
J-06
J-07
J-08
J-09
J-10
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J-18
J-19
J-20

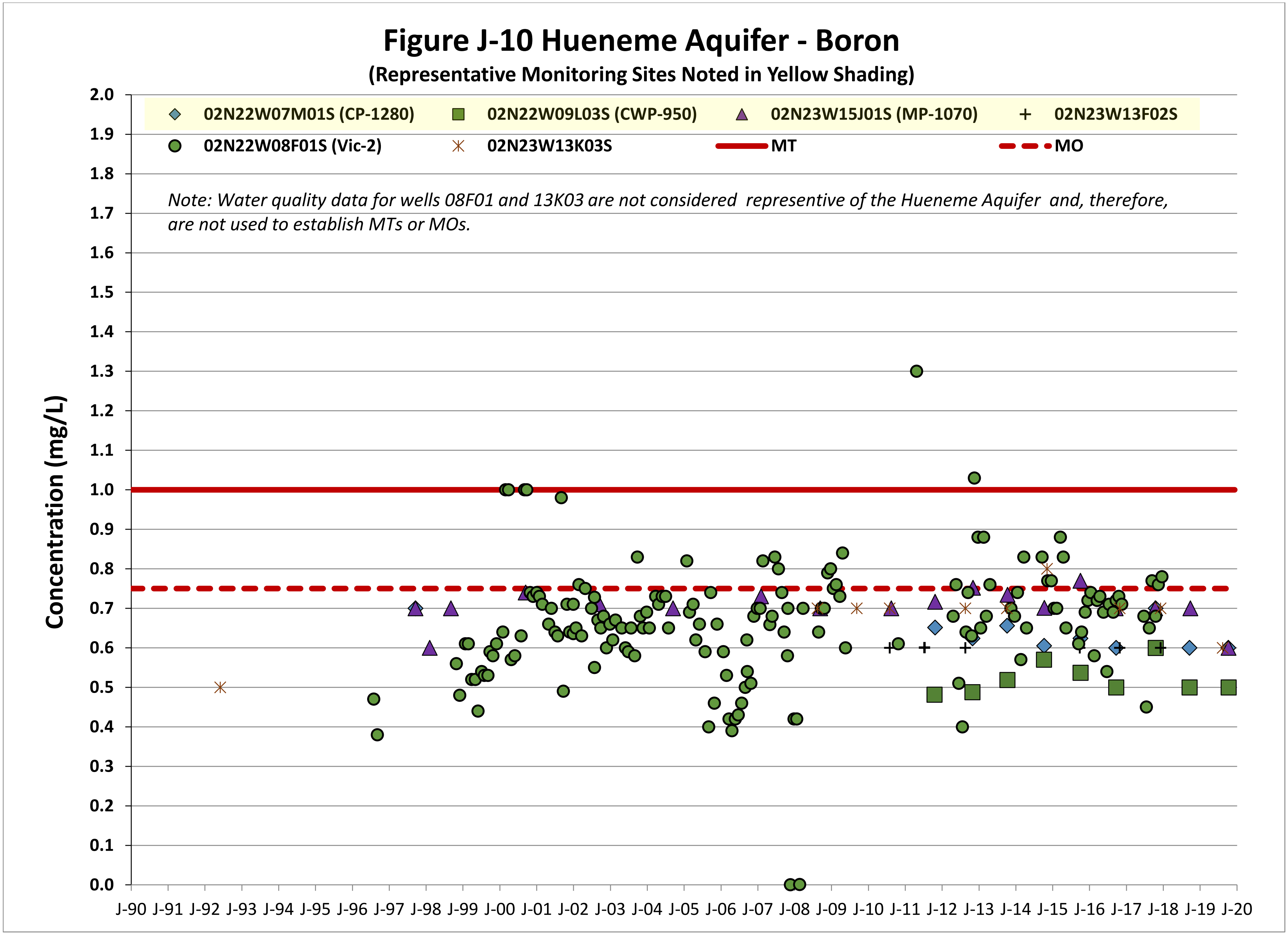


Figure J-10 Hueneme Aquifer - Boron
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MT
MO
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and, therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

Appendix K

Storage Curve Approach to Estimating Annual Change in Storage

Appendix K

Development of a "Storage Curve" to Estimate Annual Change in Groundwater in Storage In Mound Basin Using Groundwater Level Data

Introduction/Background

This appendix provides data and methodology used to develop a relationship between the historical changes in groundwater levels measured in the principal aquifers of Mound Basin and corresponding modeled changes in groundwater storage. This relationship will be used to calculate the annual storage changes in Mound Basin for the purpose of annual reporting required under the Sustainable Groundwater Management Act (SGMA) during years between future model updates by United (currently anticipated to occur approximately every 5 years).

SGMA Section 354.18(b)(4) states that "the water budget shall quantify the following, either through direct measurements or estimates based on data… the change in annual volume of groundwater in storage between seasonal high conditions." In Mound Basin, data presented in the Mound Basin Groundwater Sustainability Plan (GSP) indicate that spring is typically the season when aquifers in the region are in a positive water-balance condition (inflows exceed outflows) and groundwater levels (including potentiometric surfaces in confined aquifers) are at their highest. Changes in volume of groundwater in storage from one spring-high to the next can provide an indication of whether the aquifers have received sufficient recharge to recover from discharges during the preceding dry season (summer and fall), or whether a declining trend in storage is developing. Fall-low groundwater levels in Mound and adjacent basins can be strongly influenced by short-term, local factors such as timing of the first winter rainfall event and the presence or absence of Santa Ana winds in fall (which can result in a significant increase in demand for irrigation). Therefore, fall groundwater elevations provide a less reliable indicator of year-over-year changes in groundwater in storage compared to spring groundwater elevations.

Data Sources and Review

Groundwater elevation data available in the Mound Basin data management system were reviewed and selected for this analysis based on the following characteristics:

- Wells with a lengthy period of record (at least 20 years) of spring-high groundwater elevation measurements.
- The preferred timeframe for selection of spring-high groundwater elevations was the week of March 31 of each year. However, if no data were available that week, or if higher groundwater elevations occurred earlier or later in spring of that year, groundwater elevation data from other dates (up to several weeks earlier or later than the week of March 31) were selected to represent spring-high water levels.
- Only groundwater elevations from wells screened in principal aquifers in Mound Basin (Mugu and Hueneme Aquifers) were selected.
- Well locations had to be representative of areas of the basin where annual groundwater-level (and storage) changes were most significant, specifically along the central axis and southern portions of Mound Basin.

The clustered monitoring wells in Marina Park (02N23W15J01S and -J02S, screened in the Hueneme and Mugu aquifers, respectively) and Camino Real Park (02N22W07M01S and –M02S, also screened in the Hueneme and Mugu aquifers, respectively), together with agricultural supply well 02N22W20E01S (screened in the Hueneme Aquifer) met these criteria best. Locations of these wells are shown on Figure K-1. Spring-high groundwater elevations measured at these wells are summarized on Table K-1. The arithmetic mean (average) of the spring groundwater elevations at the five selected wells was calculated, and the change in average groundwater elevations from year to year was calculated (Table K-1). Note that years when data were not available for one or more of the selected wells, an average was not calculated. Furthermore, changes in groundwater elevation from the previous year could not be (and were not) calculated when no average was available for the prior year.

Past annual changes in groundwater in storage in Mound Basin were estimated by United's groundwater flow model, as described in Section 3.3 (water-budget analysis) of the Mound Basin GSP. However, rather than using model output to calculate water-year (October through September) changes in groundwater in storage in Mound Basin, as was conducted for the water-budget analysis presented in the GSP, model output for the end of March of each year was used to calculate changes in spring-high groundwater in storage.

Correlation Results and Development of Storage Curve

A scatterplot of annual spring-high changes in groundwater elevation versus annual changes in groundwater in storage in Mound Basin (from spring of the previous year to spring of the selected year) is shown on Figure K-2. The best-fit linear regression calculated for this relationship is:

Annual change in storage (acre-feet) = 706 (acre-feet/foot) x Annual change in average groundwater elevation (feet)

The coefficient of determination (R^2) for this relationship is 0.51.

The y-intercept in this regression was forced through the origin (the point on the graph representing zero change in groundwater elevation and zero change in storage). If this y-intercept had not been forced, the best-fit would have changed slightly to:

Annual change in storage (acre-feet) = 777 (acre-feet/foot) x Annual change in average groundwater elevation (feet) + 818 (acre-feet)

The coefficient of determination for this relationship is 0.53.

Although the equations and coefficients of determination are similar, conceptually it is logical to assume that in a year with no change in groundwater elevations in Mound Basin, the volume of groundwater in storage in the basin would not change. Therefore, the first linear regression above (with the y-intercept forced through the origin) is selected as representative of the relationship between changes in groundwater elevation and storage in the basin. In the near future, annual changes in spring-high storage in Mound Basin can be approximated using this relationship and groundwater elevation data collected from wells 02N23W15J01S, 02N23W15J02S, 02N22W07M01S, 02N22W07M02S, and 02N22W20E01S. As noted previously, changes in storage in the basin for the previous 5 years are expected to be computed via groundwater flow modeling at approximately 5-year intervals. When these model estimates are completed, the storage-curve can be modified if needed, and the modeled estimates of change in storage can be used to improve the storage-curve-based estimates of the previous 5 years.

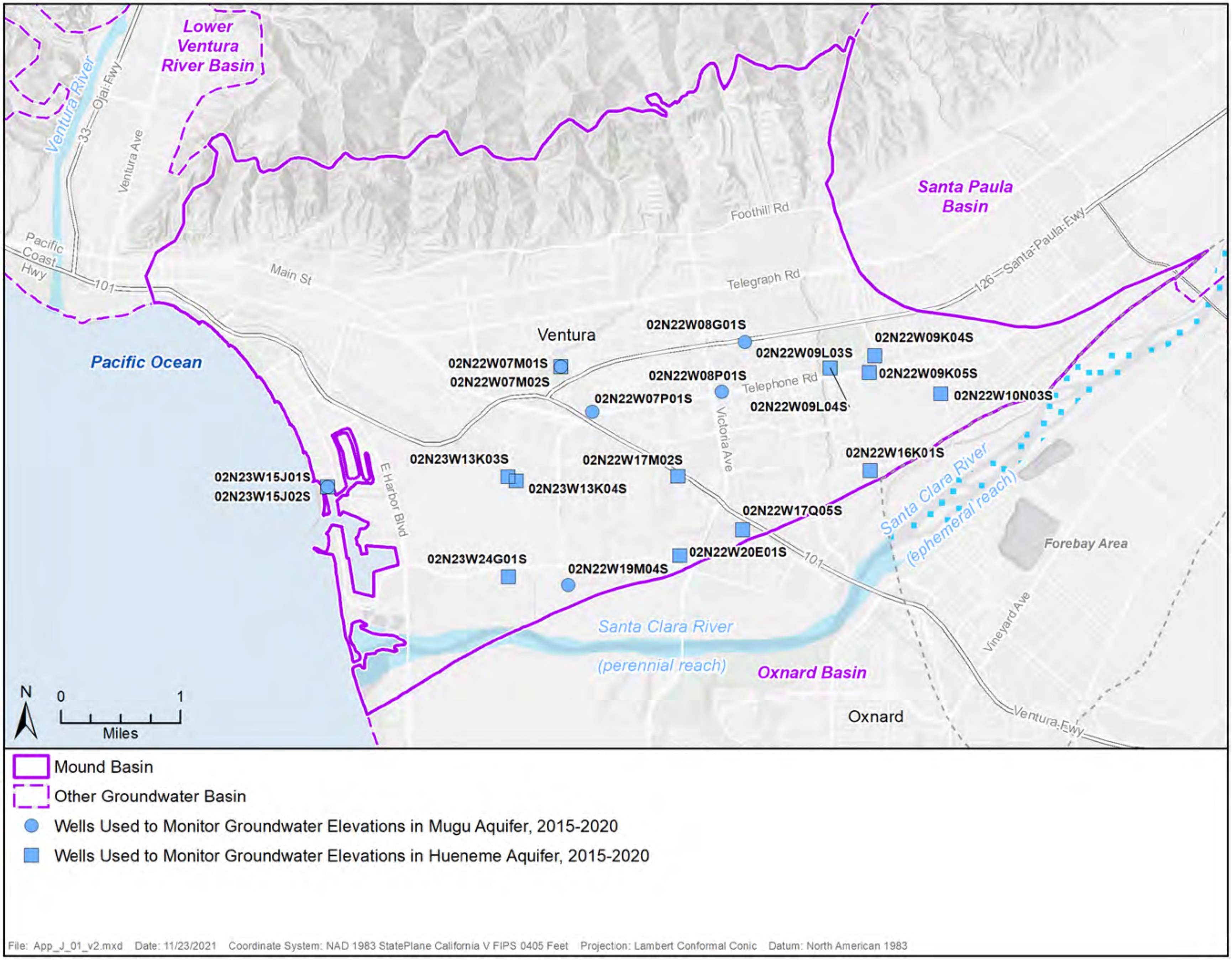


Figure K-01 Locations of Wells.

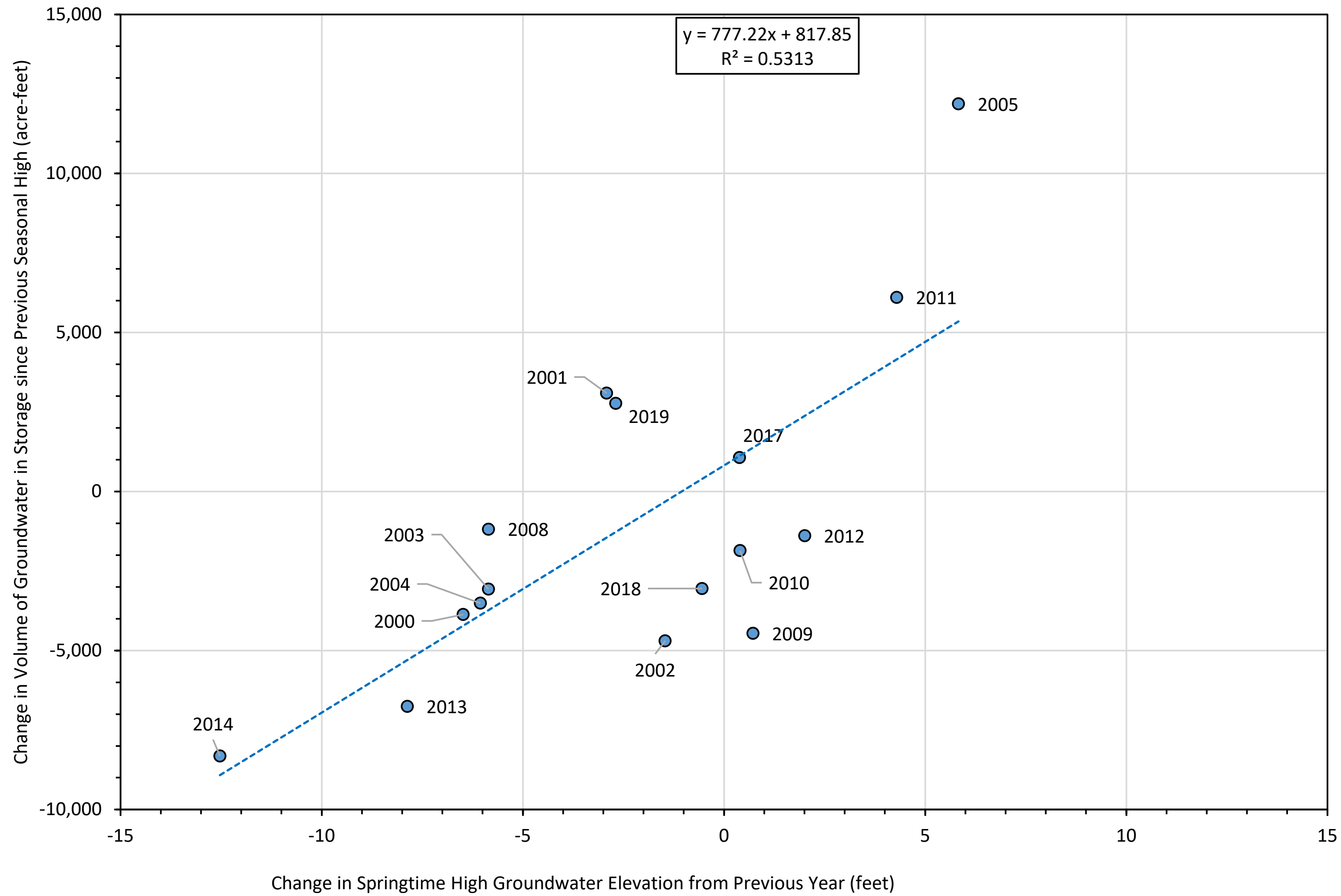


Figure K-02 Annual Spring-High Changes in Groundwater Elevation Versus Annual Changes In Groundwater In Storage In Mound Basin.

Table K-01 Groundwater Level Elevations Measured at Selected Wells and Modeled Changes in Groundwater in Storage in Mound Basin

Water Year	Average of Spring-High Groundwater Elevations Measured in Mugu and Hueneme Aquifers at Marina Park and Camino Real Park Clustered Monitoring Wells, and Supply Well 02N22W20E01S (feet, msl)	Change in Average of Spring-High Groundwater Elevations Measured in Mugu and Hueneme Aquifers at Marina Park and Camino Real Park Clustered Monitoring Wells, and Supply Well 02N22W20E01S (feet)	Change in Volume of Groundwater in Storage since Previous Seasonal High (acre-feet)	Well Identifier	Date Ground-water Level Measured	Ground-water Level (feet, msl)	Well Identifier	Date Ground-water Level Measured	Ground-water Level (feet, msl)	Well Identifier	Date Ground-water Level Measured	Ground-water Level (feet, msl)	Well Identifier	Date Ground-water Level Measured	Ground-water Level (feet, msl)	Well Identifier	Date Ground-water Level Measured	Ground-water Level (feet, msl)
1996			641	02N22W07M01S	4/15/1996	19.96	02N22W07M02S	4/15/1996	29.66	02N23W15J01S	4/15/1996	11.73	02N23W15J02S	4/15/1996	15.93			
1997			-96	02N22W07M01S	2/14/1997	21.06	02N22W07M02S	2/14/1997	30.06	02N23W15J01S	4/10/1997	7.53						
1998			8,253	02N22W07M01S	4/9/1998	29.36	02N22W07M02S	4/9/1998	37.46	02N23W15J01S	3/19/1998	13.95	02N23W15J02S	3/19/1998	23.19			
1999	27.05		-1,834	02N22W07M01S	3/31/1999	20.36	02N22W07M02S	3/31/1999	32.76	02N23W15J01S	3/30/1999	18.07	02N23W15J02S	3/30/1999	22.54	02N22W20E01S	3/18/1999	41.55
2000	20.57	-6.48	-3,869	02N22W07M01S	4/7/2000	12.46	02N22W07M02S	4/7/2000	24.86	02N23W15J01S	3/16/2000	13.41	02N23W15J02S	3/16/2000	21.03	02N22W20E01S	3/2/2000	31.09
2001	17.65	-2.92	3,094	02N22W07M01S	3/28/2001	7.06	02N22W07M02S	3/28/2001	20.76	02N23W15J01S	3/19/2001	10.76	02N23W15J02S	3/19/2001	15.60	02N22W20E01S	3/28/2001	34.07
2002	16.19	-1.46	-4,697	02N22W07M01S	3/29/2002	3.21	02N22W07M02S	3/29/2002	19.38	02N23W15J01S	3/7/2002	6.38	02N23W15J02S	3/7/2002	15.82	02N22W20E01S	2/25/2002	36.15
2003	10.33	-5.85	-3,071	02N22W07M01S	4/4/2003	2.26	02N22W07M02S	4/4/2003	16.86	02N23W15J01S	3/17/2003	5.26	02N23W15J02S	3/17/2003	12.24	02N22W20E01S	2/27/2003	15.05
2004	4.28	-6.05	-3,514	02N22W07M01S	2/4/2004	0.54	02N22W07M02S	2/6/2004	-1.24	02N23W15J01S	3/18/2004	3.17	02N23W15J02S	3/18/2004	3.78	02N22W20E01S	4/20/2004	15.15
2005	10.11	5.83	12,191	02N22W07M01S	2/7/2005	8.96	02N22W07M02S	4/7/2005	10.06	02N23W15J01S	3/1/2005	5.85	02N23W15J02S	3/18/2005	6.92	02N22W20E01S	3/9/2005	18.75
2006			-1,345	02N22W07M01S	4/13/2006	13.26	02N22W07M02S	4/13/2006	21.96	02N23W15J01S	3/15/2006	9.73	02N23W15J02S	3/15/2006	14.93			
2007	17.12		-4,908	02N22W07M01S	4/4/2007	13.16	02N22W07M02S	4/4/2007	26.06	02N23W15J01S	3/6/2007	8.65	02N23W15J02S	4/4/2007	12.63	02N22W20E01S	4/4/2007	25.11
2008	11.27	-5.85	-1,184	02N22W07M01S	2/6/2008	11.30	02N22W07M02S	4/2/2008	9.56	02N23W15J01S	3/31/2008	6.65	02N23W15J02S	3/31/2008	10.29	02N22W20E01S	4/8/2008	18.55
2009	11.99	0.72	-4,463	02N22W07M01S	3/31/2009	8.86	02N22W07M02S	3/31/2009	18.96	02N23W15J01S	3/17/2009	6.39	02N23W15J02S	3/17/2009	13.93	02N22W20E01S	2/26/2009	11.80
2010	12.39	0.40	-1,858	02N22W07M01S	4/6/2010	17.06	02N22W07M02S	2/8/2010	15.86	02N23W15J01S	3/1/2010	11.50	02N23W15J02S	3/1/2010	12.77	02N22W20E01S	4/12/2010	4.75
2011	16.68	4.29	6,103	02N22W07M01S	4/8/2011	18.68	02N22W07M02S	4/8/2011	15.77	02N23W15J01S	4/5/2011	12.77	02N23W15J02S	4/5/2011	13.35	02N22W20E01S	4/14/2011	22.84
2012	18.69	2.01	-1,389	02N22W07M01S	4/18/2012	24.88	02N22W07M02S	4/4/2012	17.68	02N23W15J01S	3/30/2012	15.20	02N23W15J02S	3/30/2012	15.43	02N22W20E01S	4/4/2012	20.25
2013	10.82	-7.87	-6,760	02N22W07M01S	3/28/2013	10.34	02N22W07M02S	3/16/2013	19.14	02N23W15J01S	3/28/2013	9.89	02N23W15J02S	3/28/2013	11.27	02N22W20E01S	3/27/2013	3.45
2014	-1.71	-12.53	-8,316	02N22W07M01S	3/24/2014	3.14	02N22W07M02S	3/10/2014	6.88	02N23W15J01S	3/26/2014	0.67	02N23W15J02S	3/26/2014	1.85	02N22W20E01S	3/21/2014	-21.11
2015			-6,837	02N22W07M01S	3/18/2015	-2.63	02N22W07M02S	3/1/2015	-0.99	02N23W15J01S	3/2/2015	-2.07	02N23W15J02S	3/2/2015	-0.09			
2016	-9.37		-3,459	02N22W07M01S	3/24/2016	1.55	02N22W07M02S	3/14/2016	2.70	02N23W15J01S	4/4/2016	-2.46	02N23W15J02S	2/26/2016	0.33	02N22W20E01S	3/23/2016	-48.97
2017	-8.99	0.38	1,064	02N22W07M01S	3/21/2017	1.73	02N22W07M02S	3/21/2017	-3.98	02N23W15J01S	2/27/2017	-3.70	02N23W15J02S	2/27/2017	-1.73	02N22W20E01S	2/28/2017	-37.26
2018	-9.54	-0.55	-3,051	02N22W07M01S	3/15/2018	0.50	02N22W07M02S	3/27/2018	-0.34	02N23W15J01S	3/29/2018	-3.75	02N23W15J02S	3/15/2018	-2.92	02N22W20E01S	3/27/2018	-41.17
2019	-12.23	-2.69	2,775	02N22W07M01S	3/6/2019	-3.57	02N22W07M02S	3/25/2019	-8.05	02N23W15J01S	3/28/2019	-8.27	02N23W15J02S	3/6/2019	-7.18	02N22W20E01S	4/8/2019	-34.08
2020	-7.26	4.97		02N22W07M01S	3/12/2020	1.10	02N22W07M02SX	3/12/2020	-7.85	02N23W15J01S	3/26/2020	-2.49	02N23W15J02S	3/12/2020	-4.99	02N22W20E01S	3/11/2020	-22.07
2021	-6.19	1.07		02N22W07M01S	1/21/2021	3.96	02N22W07M02S	3/17/2021	-7.46	02N23W15J01S	3/17/2021	-2.83	02N23W15J02S	3/17/2021	-3.58	02N22W20E01S	3/16/2021	-21.06

Notes: Blank entries represent years when no data are available or average groundwater elevations could not be calculated
feet, msl = feet above (or below, if negative) mean sea level

Appendix L

Data Management System Information

Overview

This data management system (DMS) was developed for the purpose of "storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin", per section 352.6 of the GSP regulations. The DMS was developed for use by the Mound Basin Groundwater Sustainability Agency (MBGSA).

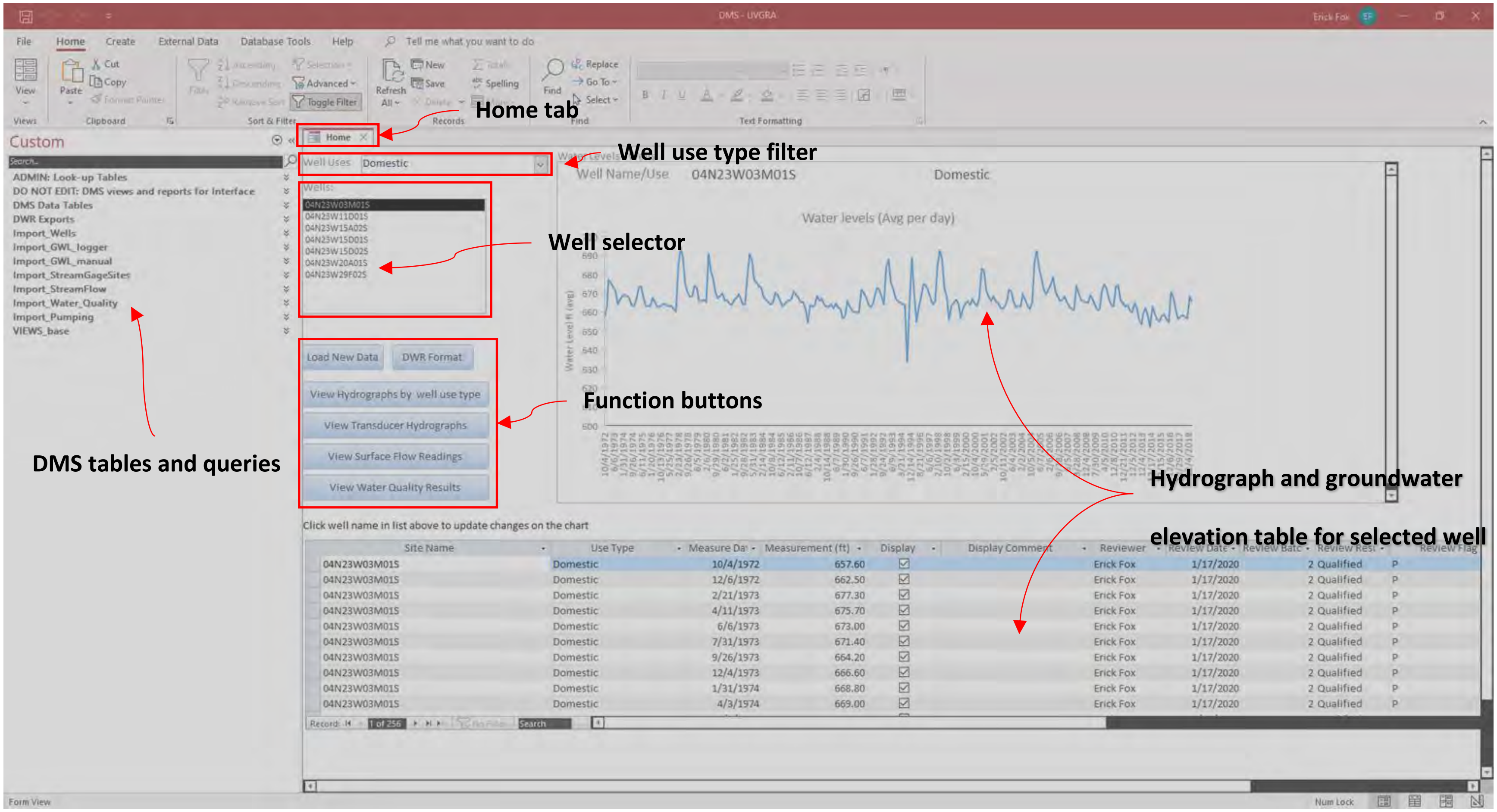
The DMS is housed in an Access database, which has the ability to import data from Excel, perform filtering and charting for some data, and export to Excel tables that are formatted according to DWR templates for upload with the GSP. The data in the DMS have undergone quality control checks prior to import in line with the UVRGA Data Quality Control Review Procedures document, adopted by the UVRGA board on September 13, 2018.

The DMS is designed to contain the following data:

- Well construction details
- Groundwater level elevations (manual measurements and logger data)
- Water quality
- Pumping
- Stream gages
- Streamflow data

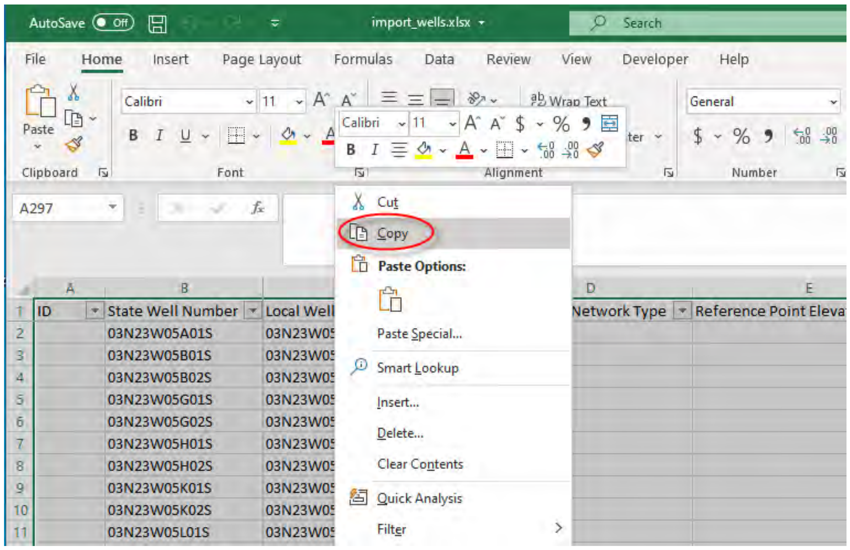
In addition to the data tables that hold the above information, the DMS also contains a number of tables and queries that are used for importing, data format verification, and other backend functions. See DMS Object Description (attached) for a description of these tables and queries. DMS Object Map (attached) shows how these tables and queries are used for the import and export functions.

The default starting view shows the Home tab that contains a dropdown list of wells filtered by use type, a hydrograph and groundwater elevation data table for the selected well, and several buttons that can be used to access certain functions of the DMS—see screenshot next page. (If the Home tab is not visible, expand the DMS views and reports for Interface group in the table of contents on the left hand side of the screen, and open chart_WaterLevels_wells.)

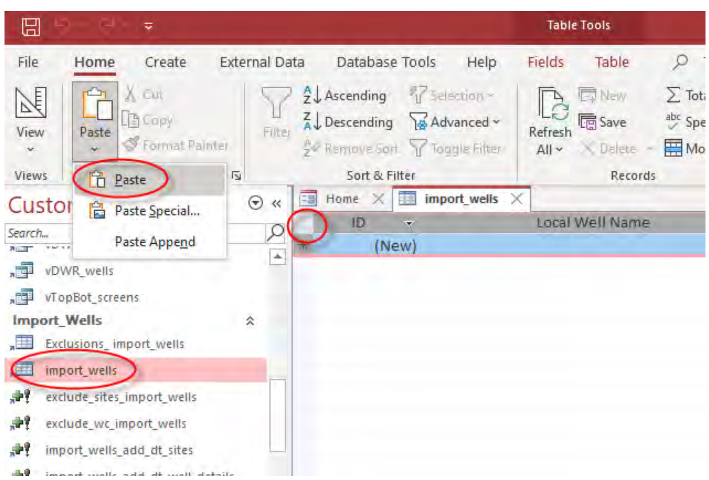

Home tab
Well use type filter
Well selector
Function buttons
DMS tables and queries
Hydrograph and groundwater
elevation table for selected well

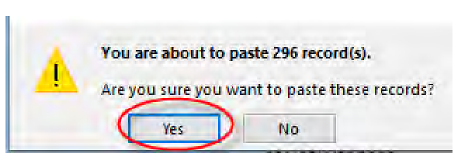
Importing Well Site Details

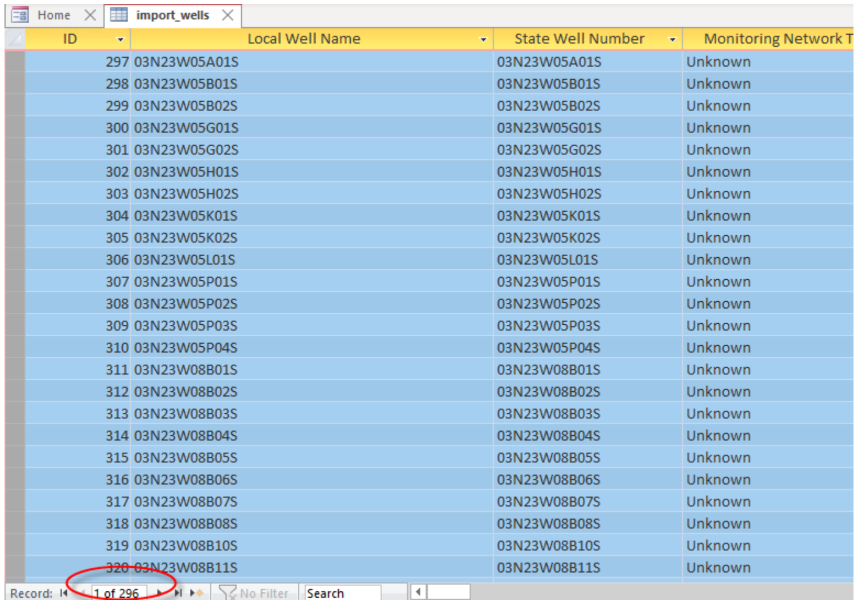
1. Format the data in Excel according to the "import_wells.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_wells" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_wells" table is equal to the number of rows copied from Excel.

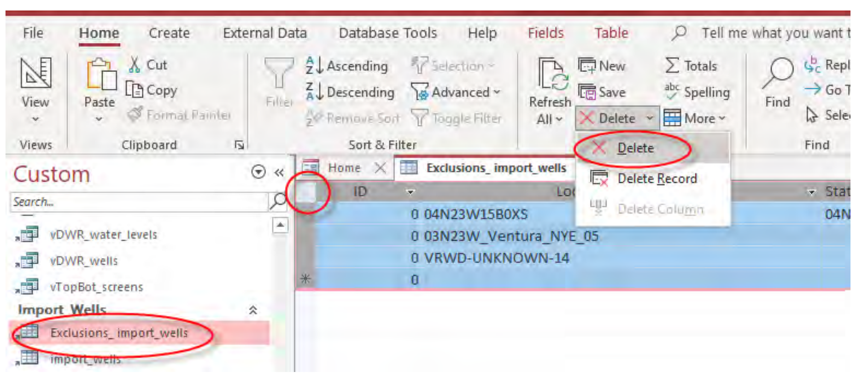




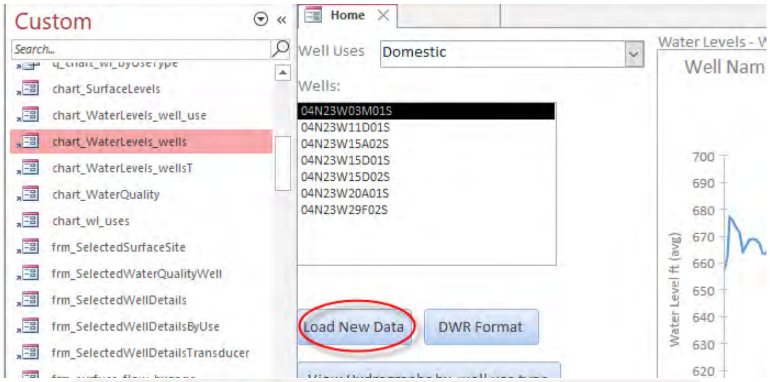


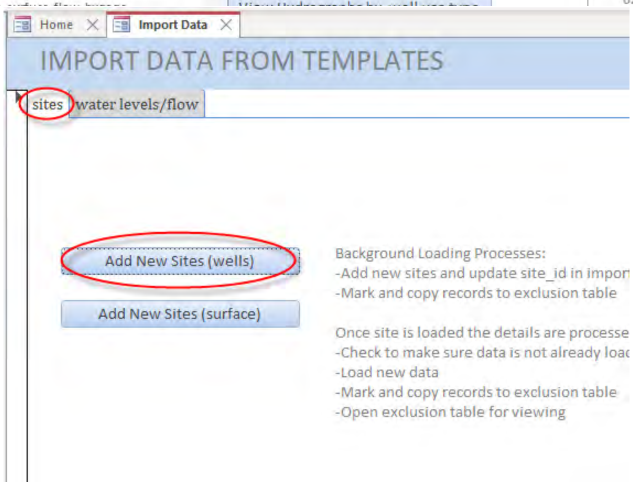
ID	Local Well Name	State Well Number	Monitoring Network T
297	03N23W05A01S	03N23W05A01S	Unknown
298	03N23W05B01S	03N23W05B01S	Unknown
299	03N23W05B02S	03N23W05B02S	Unknown
300	03N23W05G01S	03N23W05G01S	Unknown
301	03N23W05G02S	03N23W05G02S	Unknown
302	03N23W05H01S	03N23W05H01S	Unknown
303	03N23W05H02S	03N23W05H02S	Unknown
304	03N23W05K01S	03N23W05K01S	Unknown
305	03N23W05K02S	03N23W05K02S	Unknown
306	03N23W05L01S	03N23W05L01S	Unknown
307	03N23W05P01S	03N23W05P01S	Unknown
308	03N23W05P02S	03N23W05P02S	Unknown
309	03N23W05P03S	03N23W05P03S	Unknown
310	03N23W05P04S	03N23W05P04S	Unknown
311	03N23W08B01S	03N23W08B01S	Unknown
312	03N23W08B02S	03N23W08B02S	Unknown
313	03N23W08B03S	03N23W08B03S	Unknown
314	03N23W08B04S	03N23W08B04S	Unknown
315	03N23W08B05S	03N23W08B05S	Unknown
316	03N23W08B06S	03N23W08B06S	Unknown
317	03N23W08B07S	03N23W08B07S	Unknown
318	03N23W08B08S	03N23W08B08S	Unknown
319	03N23W08B10S	03N23W08B10S	Unknown
320	03N23W08B11S	03N23W08B11S	Unknown

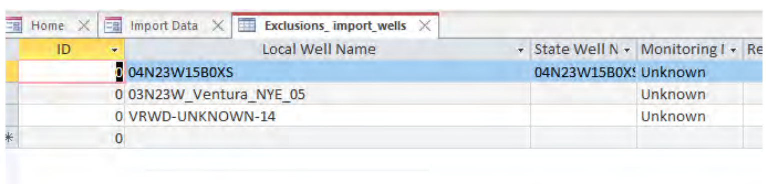
3. Open the "Exclusions_import_wells" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add New Sites (wells)" button under the "Sites" tab. This adds the new acceptable data from the "import_wells" table to the master "dt_sites" and "dt_well_details" tables and opens the "Exclusions_import_wells" table to show which new data were not added to the master tables due to missing information.





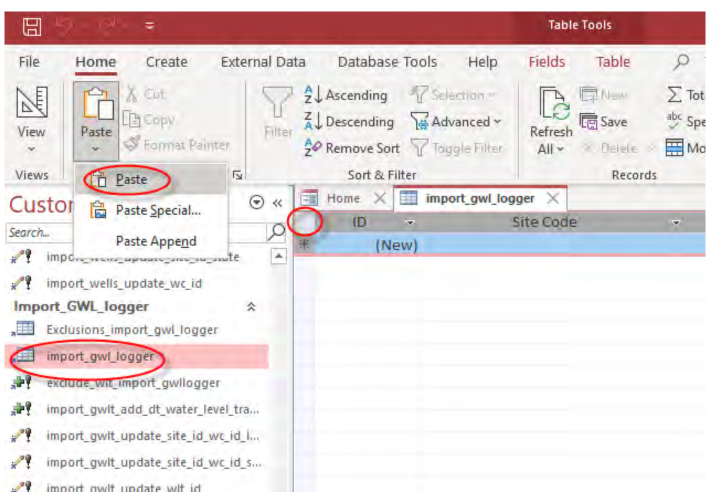


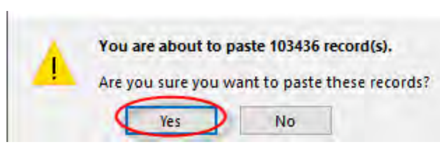
5. For the new data that were not added to the master "dt_sites" and "dt_well_details" tables (i.e., records showing up in the "Exclusions_import_wells" table), go back to the Excel template in Step 1, add the missing details (e.g., latitude, longitude, coordinates method, coordinates accuracy, and county), and repeat Steps 1 – 4.

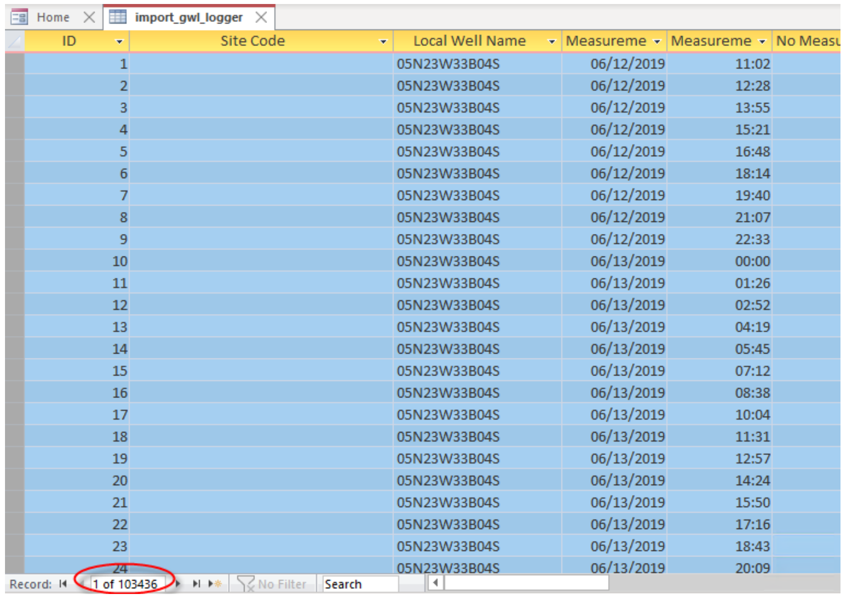
Importing Electronic Logger GWL Data

1. Format the data in Excel according to the "import_gwl_logger.xlsx" file. Make sure that the Measurement Date is in the correct format. Select and copy the data to be imported to DMS (including column headers).

2. Import to DMS by opening the "import_gwl_logger" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_gwl_logger" table is equal to the number of rows copied from Excel.



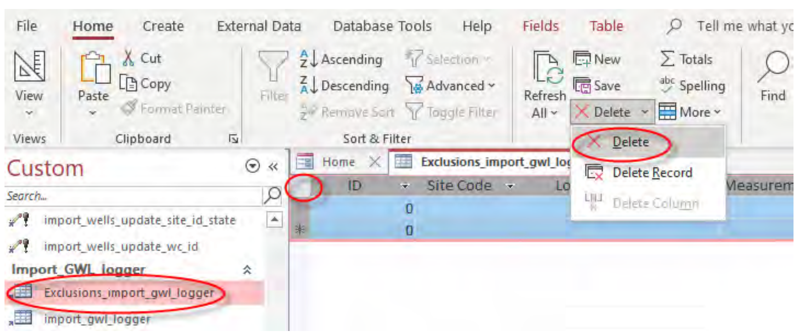




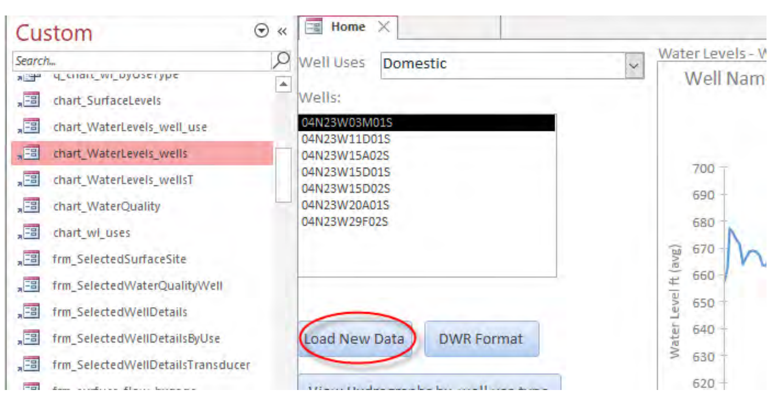
ID	Site Code	Local Well Name	Measureme	Measureme	No Measu
1		05N23W33B04S	06/12/2019	11:02	
2		05N23W33B04S	06/12/2019	12:28	
3		05N23W33B04S	06/12/2019	13:55	
4		05N23W33B04S	06/12/2019	15:21	
5		05N23W33B04S	06/12/2019	16:48	
6		05N23W33B04S	06/12/2019	18:14	
7		05N23W33B04S	06/12/2019	19:40	
8		05N23W33B04S	06/12/2019	21:07	
9		05N23W33B04S	06/12/2019	22:33	
10		05N23W33B04S	06/13/2019	00:00	
11		05N23W33B04S	06/13/2019	01:26	
12		05N23W33B04S	06/13/2019	02:52	
13		05N23W33B04S	06/13/2019	04:19	
14		05N23W33B04S	06/13/2019	05:45	
15		05N23W33B04S	06/13/2019	07:12	
16		05N23W33B04S	06/13/2019	08:38	
17		05N23W33B04S	06/13/2019	10:04	
18		05N23W33B04S	06/13/2019	11:31	
19		05N23W33B04S	06/13/2019	12:57	
20		05N23W33B04S	06/13/2019	14:24	
21		05N23W33B04S	06/13/2019	15:50	
22		05N23W33B04S	06/13/2019	17:16	
23		05N23W33B04S	06/13/2019	18:43	
24		05N23W33B04S	06/13/2019	20:09	

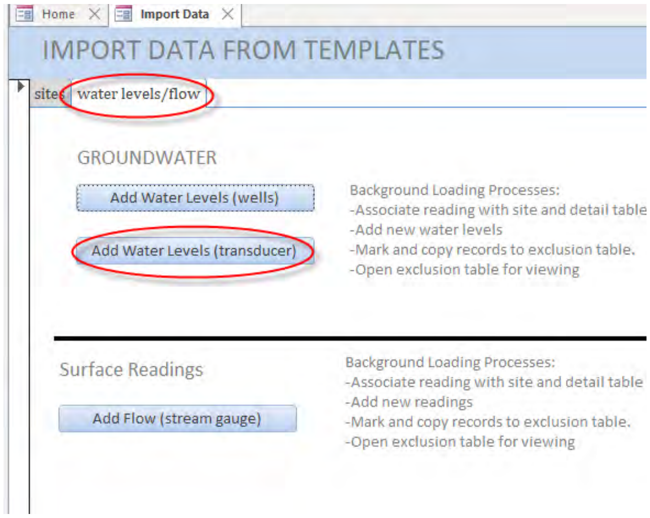
Record: 1 of 103436

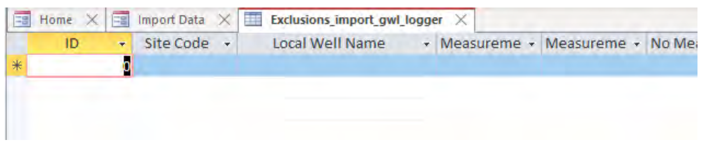
3. Open the "Exclusions_import_gwl_logger" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Water Levels (transducer)" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_gwl_logger" table to the master "dt_water_levels_transducer" table and opens the "Exclusions_import_gwl_logger" table to show which new data were not added to the master table due to missing information.







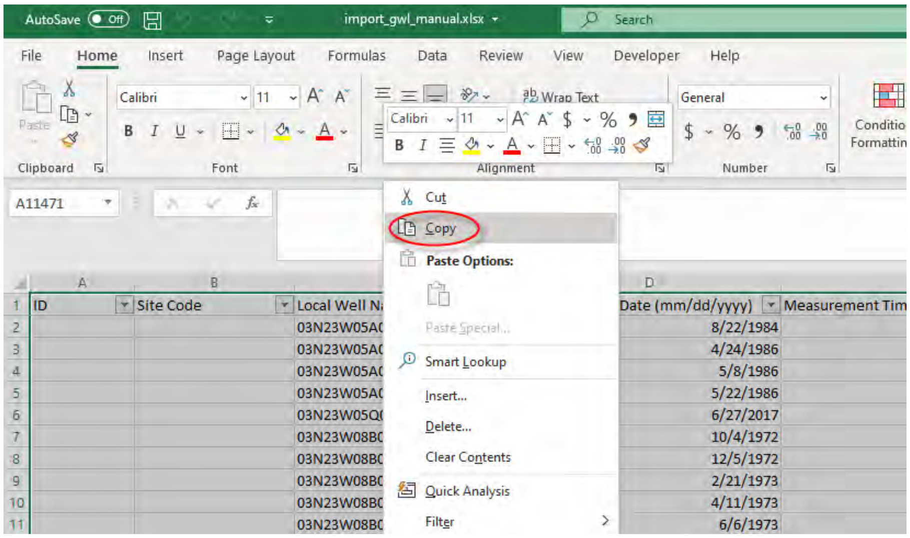
5. For the new data that were not added to the master "dt_water_levels_transducer" table (i.e., records showing up in the "Exclusions_import_gwl_logger" table), check the Site Code and Local Well Name and make sure that they exist in the "dt_sites" and "dt_well_details" tables.

   If the Site Code, Local Well Name, or any field in the GWL logger data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

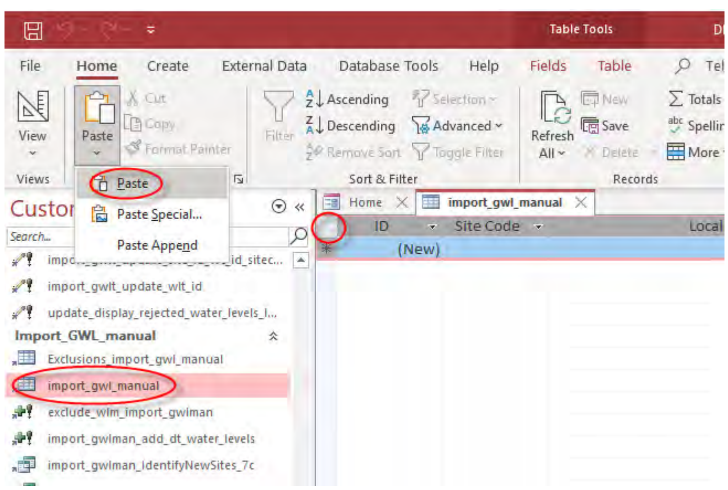
   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

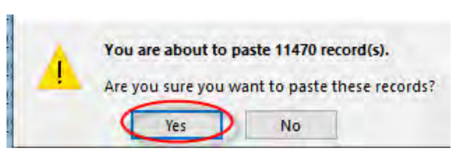
Importing Manual GWL Data

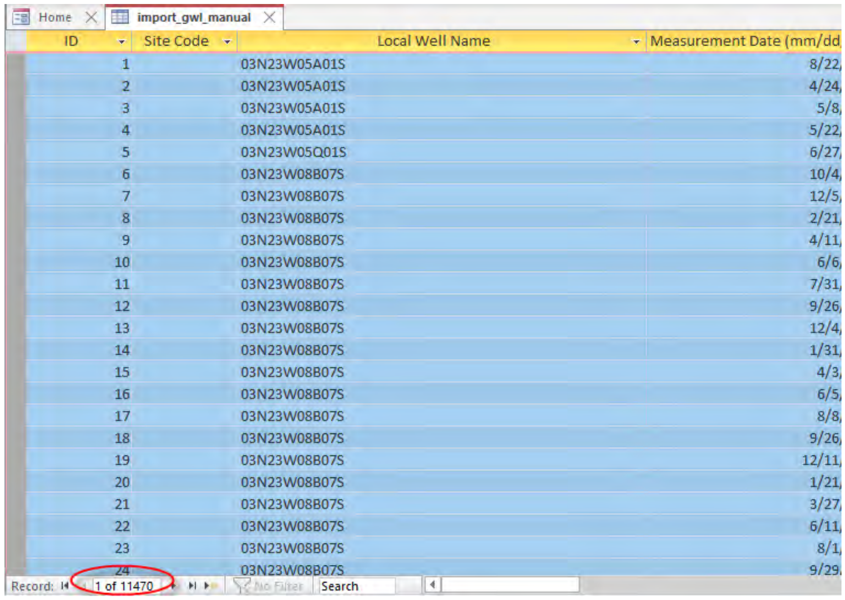
1. Format the data in Excel according to the "import_gwl_manual.xlsx" file. Make sure that the Measurement Date is in the correct format. Select and copy the data to be imported to DMS (including column headers).



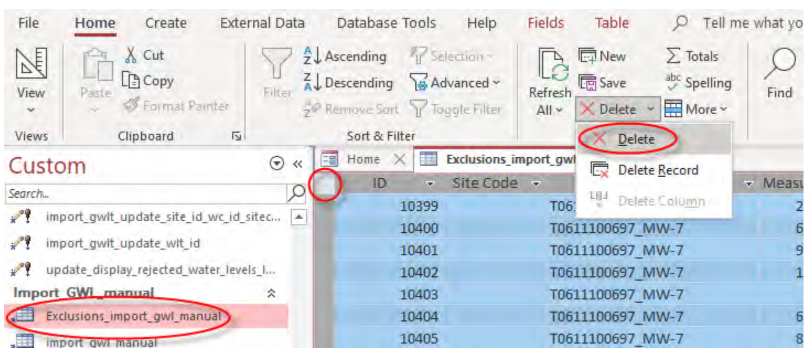
2. Import to DMS by opening the "import_gwl_manual" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_gwl_manual" table is equal to the number of rows copied from Excel.



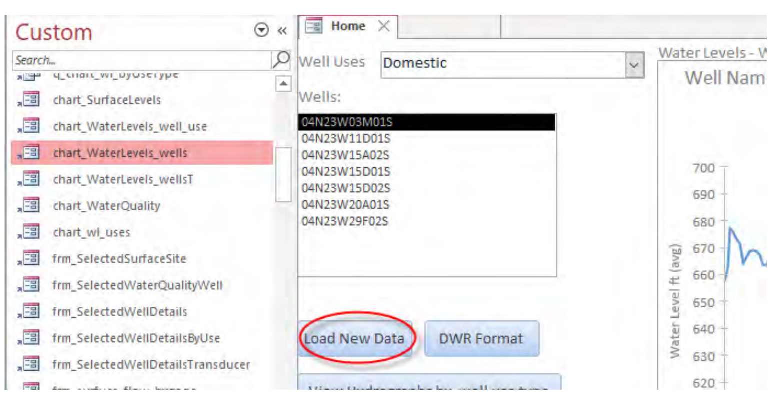


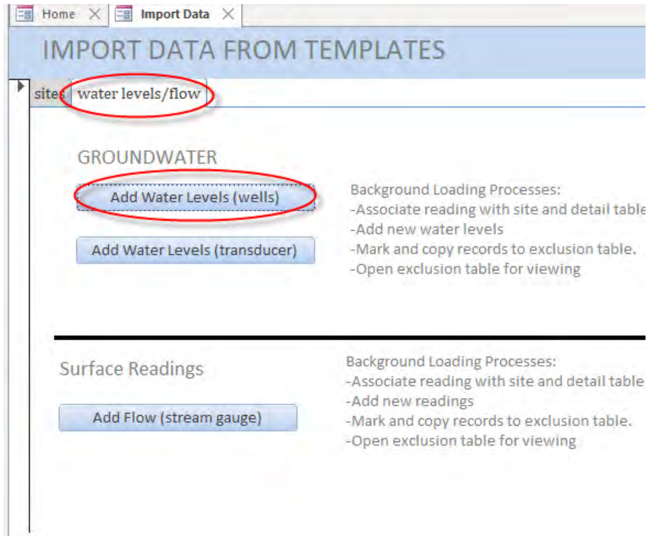


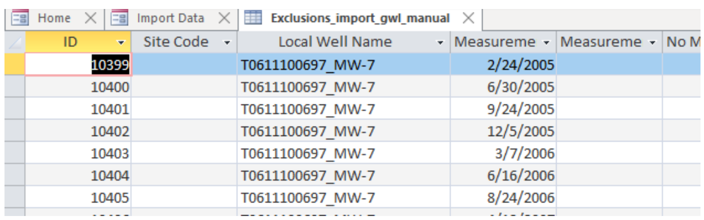
3. Open the “Exclusions_import_gwl_manual” table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the “chart_WaterLevels_wells” form, i.e. the Home tab (if not already open). Click the “Load New Data” button and then the “Add Water Levels (wells)” button under the “water levels/flow” tab. This adds the new acceptable data from the “import_gwl_manual” table to the master “dt_water_levels” table and opens the “Exclusions_import_gwl_manual” table to show which new data were not added to the master table due to missing information.







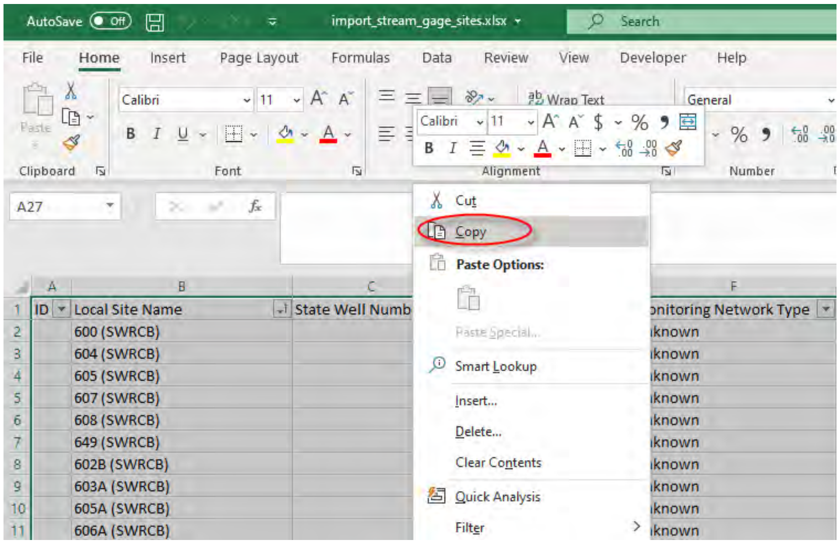
5. For the new data that were not added to the master "dt_water_levels" table (i.e., records showing up in the "Exclusions_import_gwl_manual" table), check the Local Well Name and make sure that it exists in the "dt_sites" and "dt_well_details" tables.

   If the Local Well Name or any field in the GWL manual data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

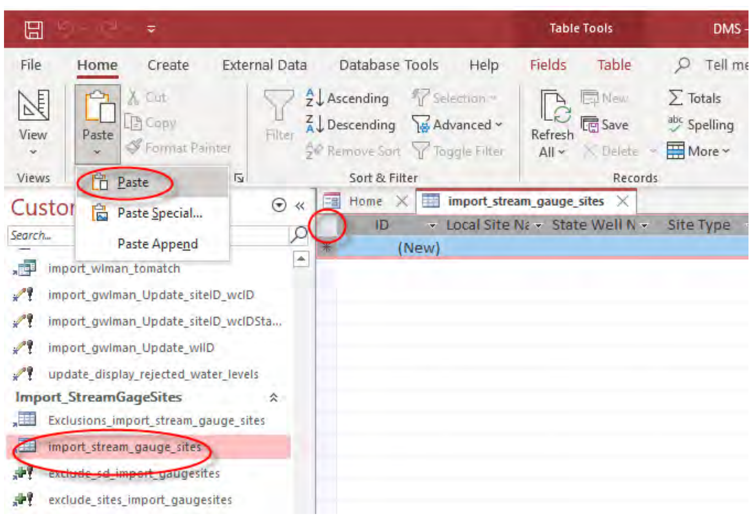
   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

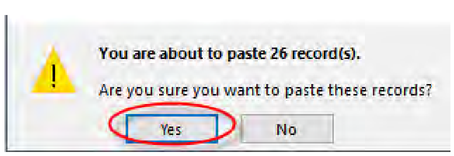
Importing Stream Gage Site Details

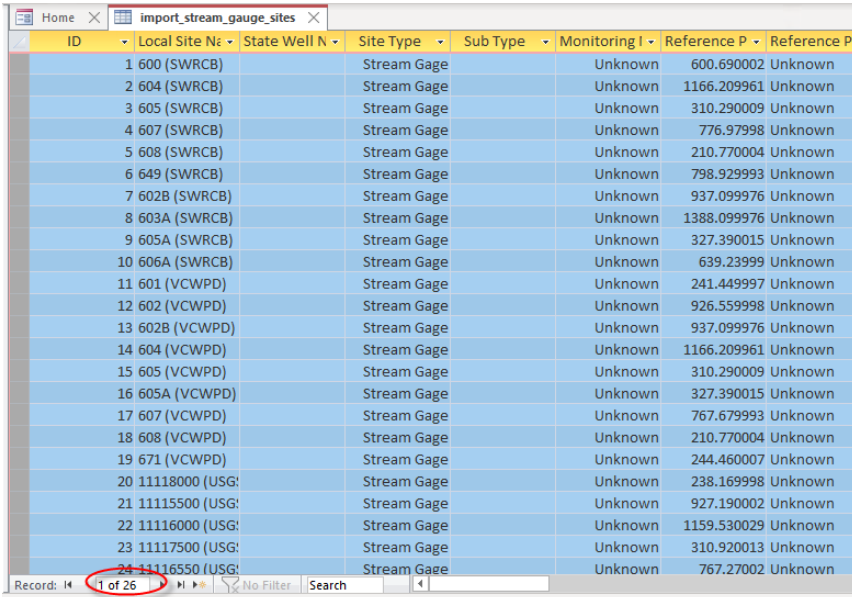
1. Format the data in Excel according to the "import_stream_gage_sites.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_stream_gauge_sites" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_stream_gauge_sites" table is equal to the number of rows copied from Excel.



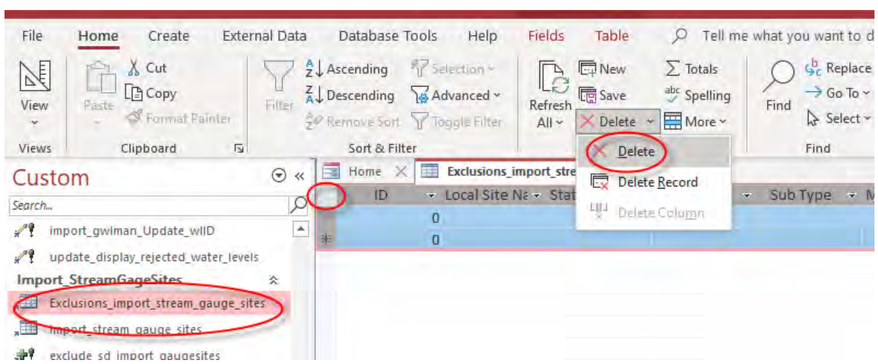




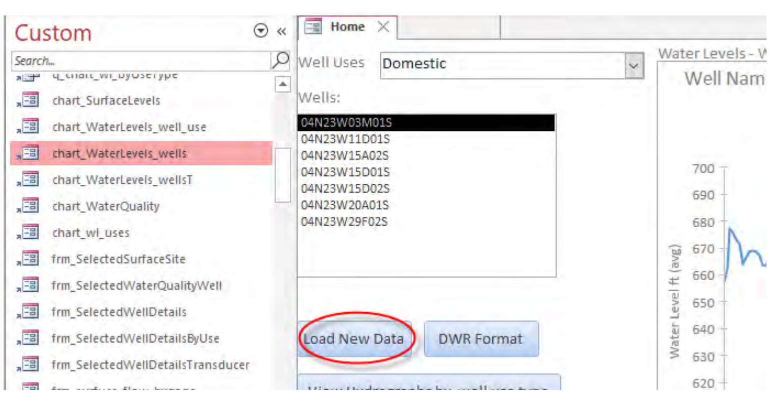
ID	Local Site Na	State Well N	Site Type	Sub Type	Monitoring I	Reference P	Reference P
1	600 (SWRCB)		Stream Gage		Unknown	600.690002	Unknown
2	604 (SWRCB)		Stream Gage		Unknown	1166.209961	Unknown
3	605 (SWRCB)		Stream Gage		Unknown	310.290009	Unknown
4	607 (SWRCB)		Stream Gage		Unknown	776.97998	Unknown
5	608 (SWRCB)		Stream Gage		Unknown	210.770004	Unknown
6	649 (SWRCB)		Stream Gage		Unknown	798.929993	Unknown
7	602B (SWRCB)		Stream Gage		Unknown	937.099976	Unknown
8	603A (SWRCB)		Stream Gage		Unknown	1388.099976	Unknown
9	605A (SWRCB)		Stream Gage		Unknown	327.390015	Unknown
10	606A (SWRCB)		Stream Gage		Unknown	639.23999	Unknown
11	601 (VCWPD)		Stream Gage		Unknown	241.449997	Unknown
12	602 (VCWPD)		Stream Gage		Unknown	926.559998	Unknown
13	602B (VCWPD)		Stream Gage		Unknown	937.099976	Unknown
14	604 (VCWPD)		Stream Gage		Unknown	1166.209961	Unknown
15	605 (VCWPD)		Stream Gage		Unknown	310.290009	Unknown
16	605A (VCWPD)		Stream Gage		Unknown	327.390015	Unknown
17	607 (VCWPD)		Stream Gage		Unknown	767.679993	Unknown
18	608 (VCWPD)		Stream Gage		Unknown	210.770004	Unknown
19	671 (VCWPD)		Stream Gage		Unknown	244.460007	Unknown
20	11118000 (USG:		Stream Gage		Unknown	238.169998	Unknown
21	11115500 (USG:		Stream Gage		Unknown	927.190002	Unknown
22	11116000 (USG:		Stream Gage		Unknown	1159.530029	Unknown
23	11117500 (USG:		Stream Gage		Unknown	310.920013	Unknown
24	11116550 (USG:		Stream Gage		Unknown	767.27002	Unknown

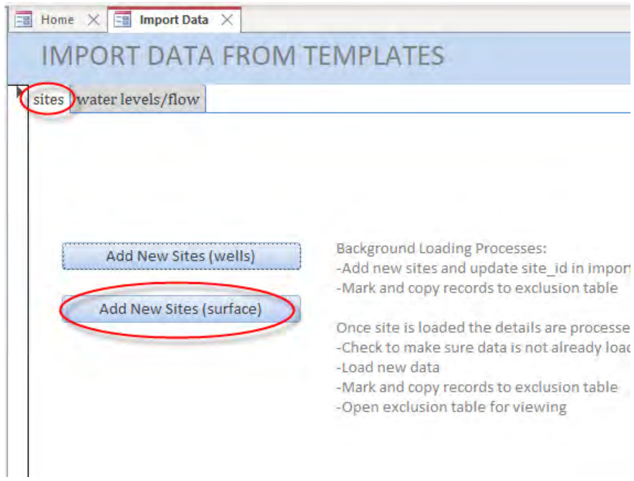
Record: 1 of 26

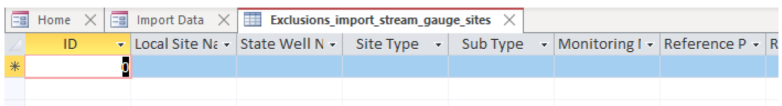
3. Open the "Exclusions_import_stream_gauge_sites" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add New Sites (surface)" button under the "Sites" tab. This adds the new acceptable data from the "import_stream_gauge_sites" table to the master "dt_sites" and "dt_site_details" tables and opens the "Exclusions_import_stream_gauge_sites" table to show which new data were not added to the master tables due to missing information.



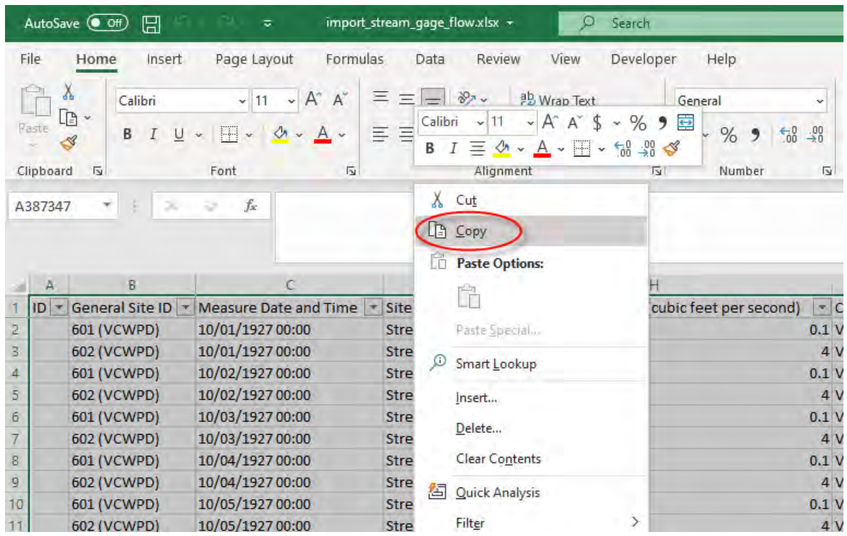




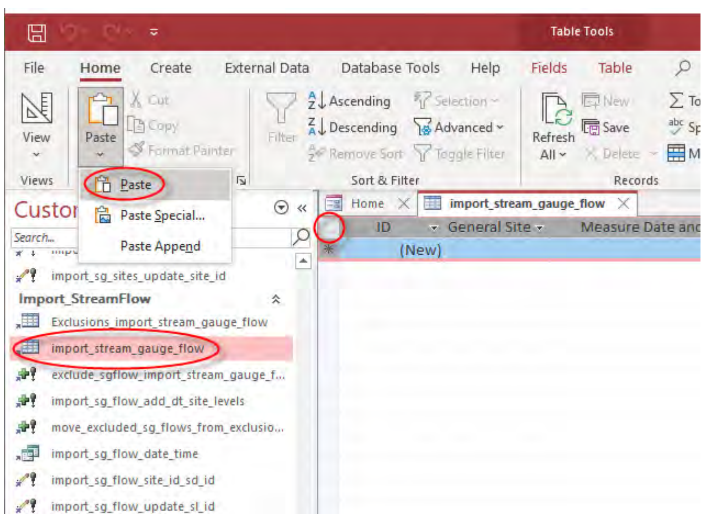
5. For the new data that were not added to the master "dt_sites" and "dt_site_details" tables (i.e., records showing up in the "Exclusions_import_stream_gauge_sites" table), go back to the Excel template in Step 1, add the missing details (e.g., latitude, longitude, coordinates method, coordinates accuracy, and county), and repeat Steps 1 – 4.

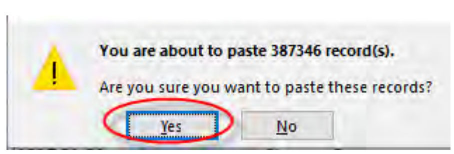
Importing Streamflow Data

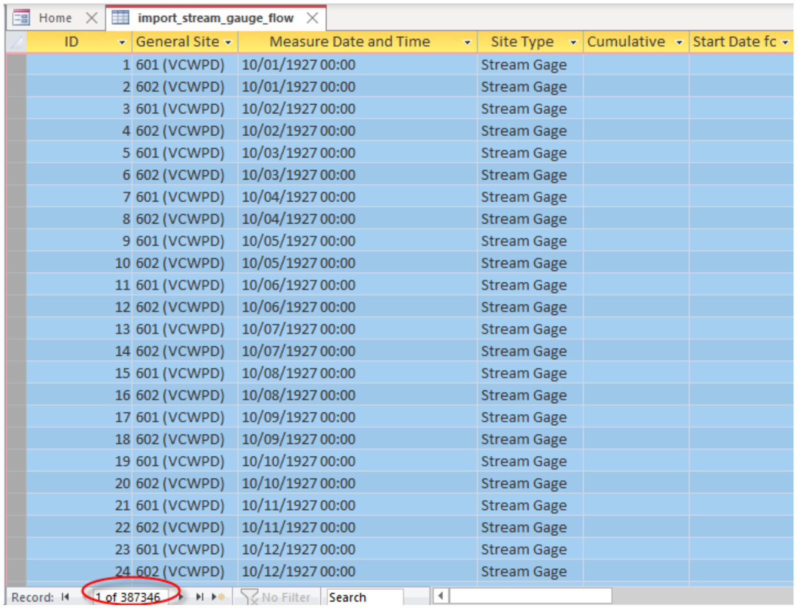
1. Format the data in Excel according to the "import_stream_gage_flow.xlsx" file. <u>Make sure that the Measure Date and Time is in the correct format and that the Surface Water Discharge (cubic feet per second) is not missing.</u> Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_stream_gauge_flow" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_stream_gauge_flow" table is equal to the number of rows copied from Excel.

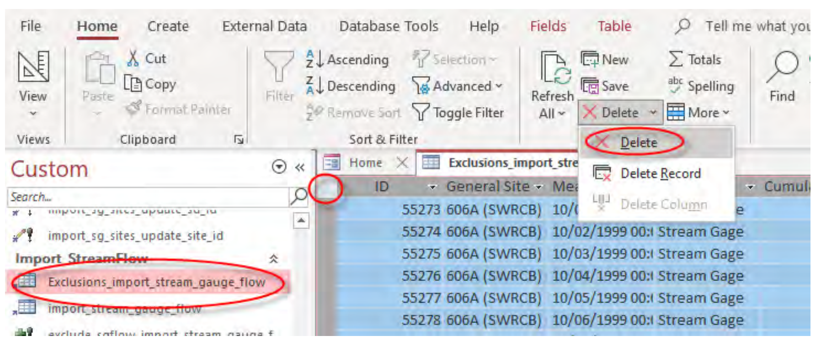




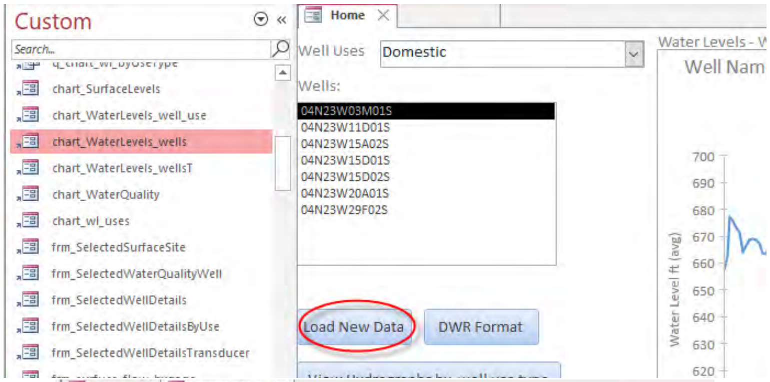


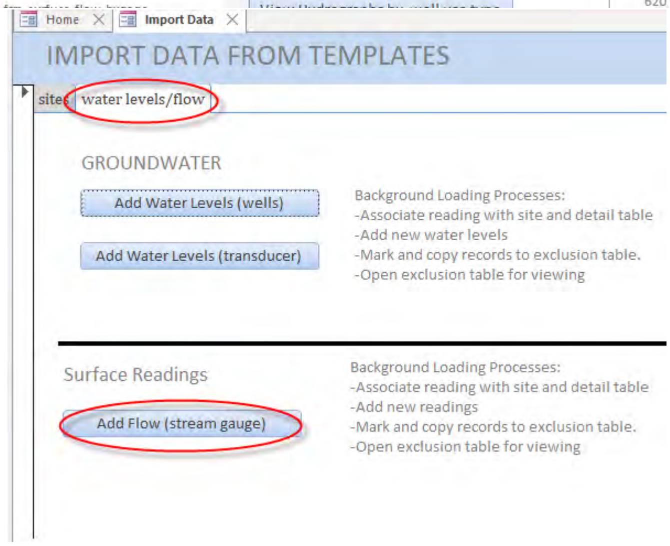
ID	General Site	Measure Date and Time	Site Type	Cumulative	Start Date fc
1	601 (VCWPD)	10/01/1927 00:00	Stream Gage		
2	602 (VCWPD)	10/01/1927 00:00	Stream Gage		
3	601 (VCWPD)	10/02/1927 00:00	Stream Gage		
4	602 (VCWPD)	10/02/1927 00:00	Stream Gage		
5	601 (VCWPD)	10/03/1927 00:00	Stream Gage		
6	602 (VCWPD)	10/03/1927 00:00	Stream Gage		
7	601 (VCWPD)	10/04/1927 00:00	Stream Gage		
8	602 (VCWPD)	10/04/1927 00:00	Stream Gage		
9	601 (VCWPD)	10/05/1927 00:00	Stream Gage		
10	602 (VCWPD)	10/05/1927 00:00	Stream Gage		
11	601 (VCWPD)	10/06/1927 00:00	Stream Gage		
12	602 (VCWPD)	10/06/1927 00:00	Stream Gage		
13	601 (VCWPD)	10/07/1927 00:00	Stream Gage		
14	602 (VCWPD)	10/07/1927 00:00	Stream Gage		
15	601 (VCWPD)	10/08/1927 00:00	Stream Gage		
16	602 (VCWPD)	10/08/1927 00:00	Stream Gage		
17	601 (VCWPD)	10/09/1927 00:00	Stream Gage		
18	602 (VCWPD)	10/09/1927 00:00	Stream Gage		
19	601 (VCWPD)	10/10/1927 00:00	Stream Gage		
20	602 (VCWPD)	10/10/1927 00:00	Stream Gage		
21	601 (VCWPD)	10/11/1927 00:00	Stream Gage		
22	602 (VCWPD)	10/11/1927 00:00	Stream Gage		
23	601 (VCWPD)	10/12/1927 00:00	Stream Gage		
24	602 (VCWPD)	10/12/1927 00:00	Stream Gage		

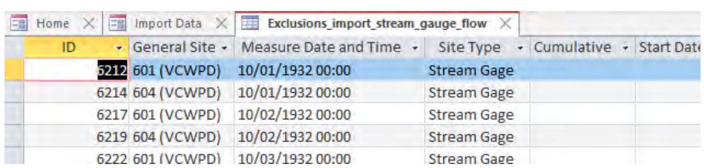
3. Open the "Exclusions_import_stream_gauge_flow" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Flow (stream gauge)" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_stream_gauge_flow" table to the master "dt_site_levels" table and opens the "Exclusions_import_stream_gauge_flow" table to show which new data were not added to the master table due to missing information.







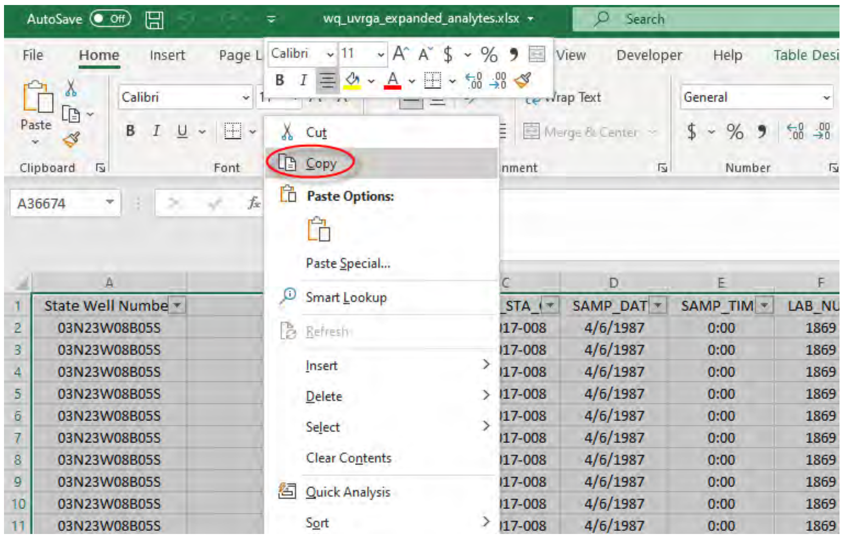
5. For the new data that were not added to the master "dt_site_levels" table (i.e., records showing up in the "Exclusions_import_stream_gauge_flow" table), check the General Site ID and make sure that it exists in the "dt_sites" and "dt_site_details" tables.

   If the General Site ID or any field in the streamflow data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

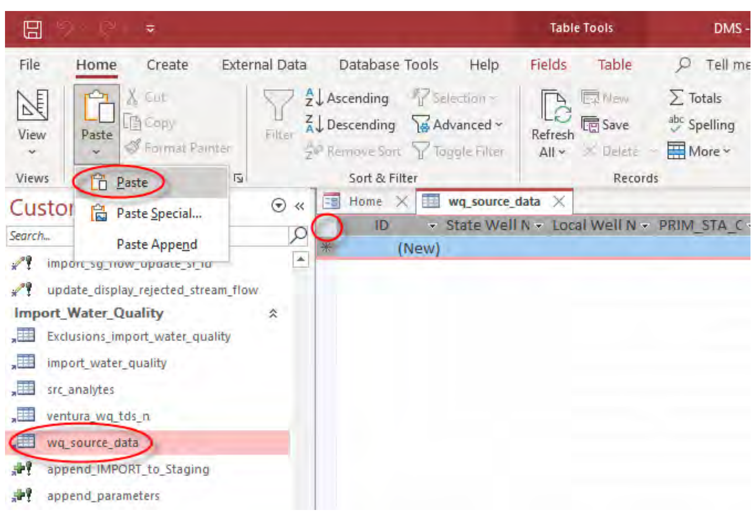
   If the site information does not exist in the "dt_sites" or "dt_site_details" table, then follow the steps for "Importing Stream Gage Site Data."

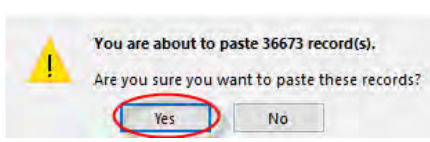
Importing Water Quality Data

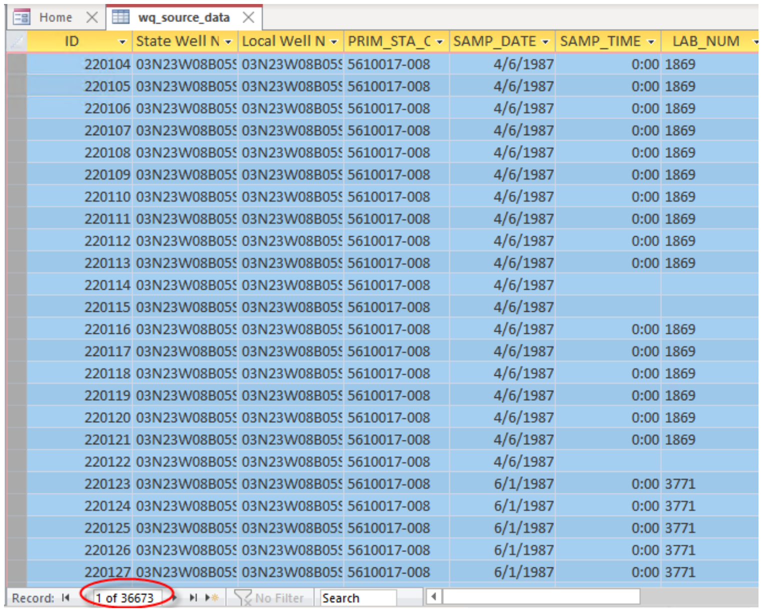
1. Format the data in Excel according to the "import_wq.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



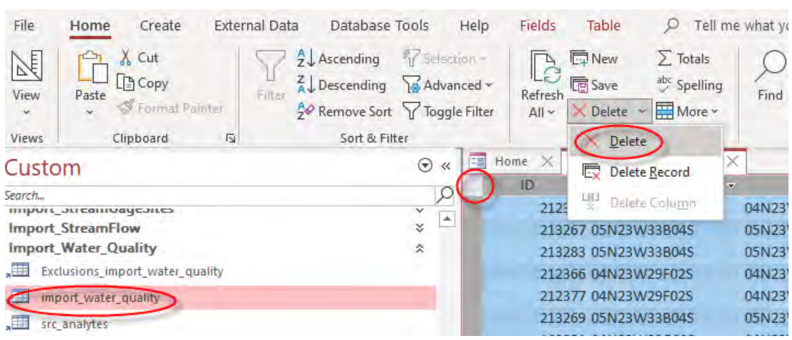
2. Import to DMS by opening the "wq_source_data" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "wq_source_data" table is equal to the number of rows copied from Excel.



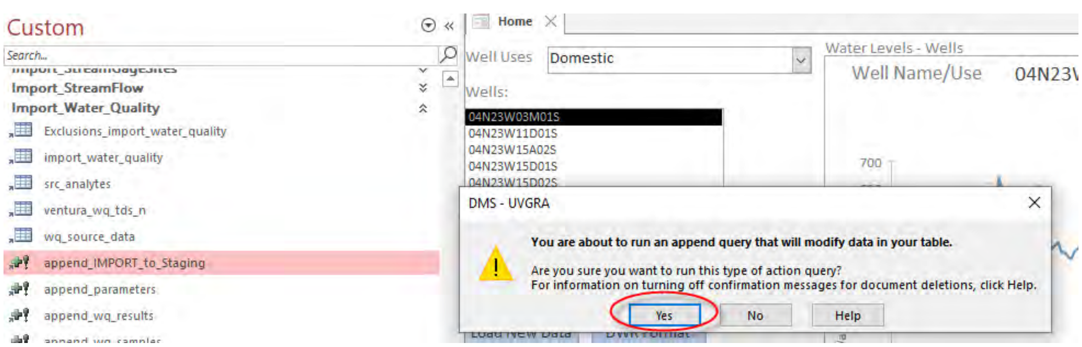


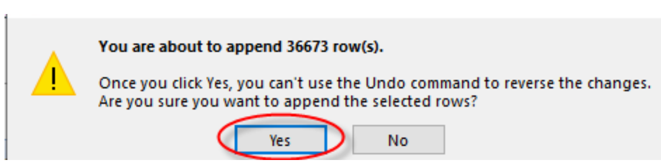


3. Open the "import_water_quality" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.

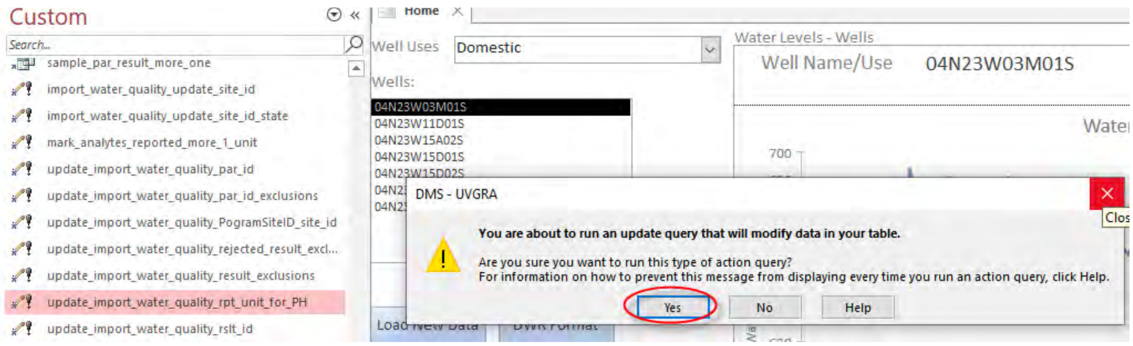


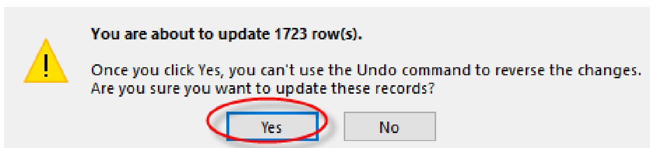
4. Run the "append_IMPORT_to_Staging" query. Click "Yes" to confirm. This adds the source data from the "wq_source_data" table to the "import_water_quality" table.





5. Run the “update_import_water_quality_rpt_unit_for_PH” query. Click “Yes” to confirm. This assigns the unit S.U. to the PH laboratory analytes.

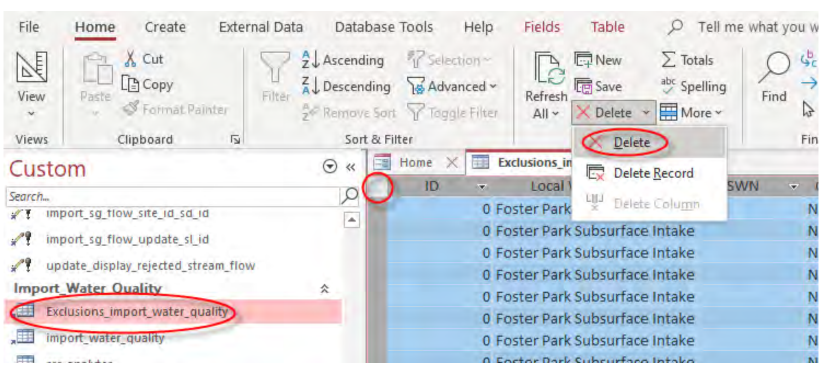




6. Run the following queries:
   check_each_chem_reported_in_one_unit – to check the unit of each analyte.
   chemicals_results_multiple_units – to identify the analytes reported in more than one unit.

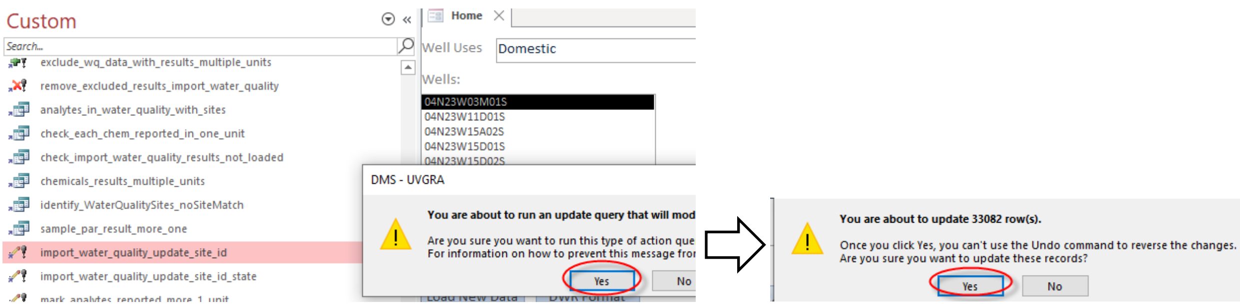
   If the units need to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 5.

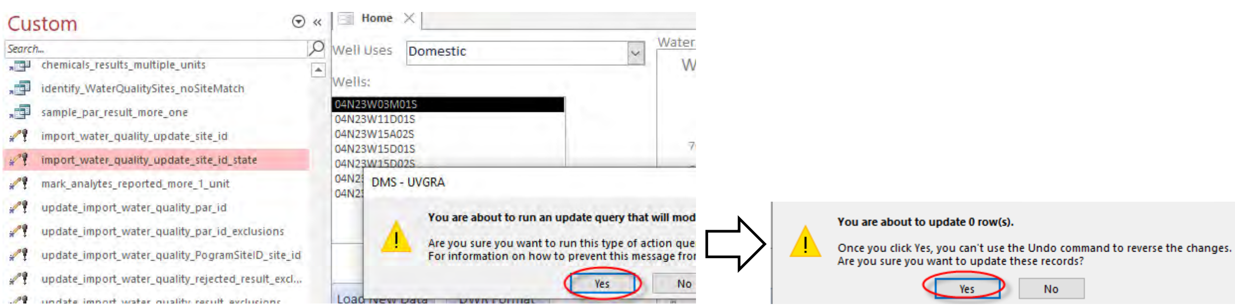
7. Open the “Exclusions_import_water_quality” table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.

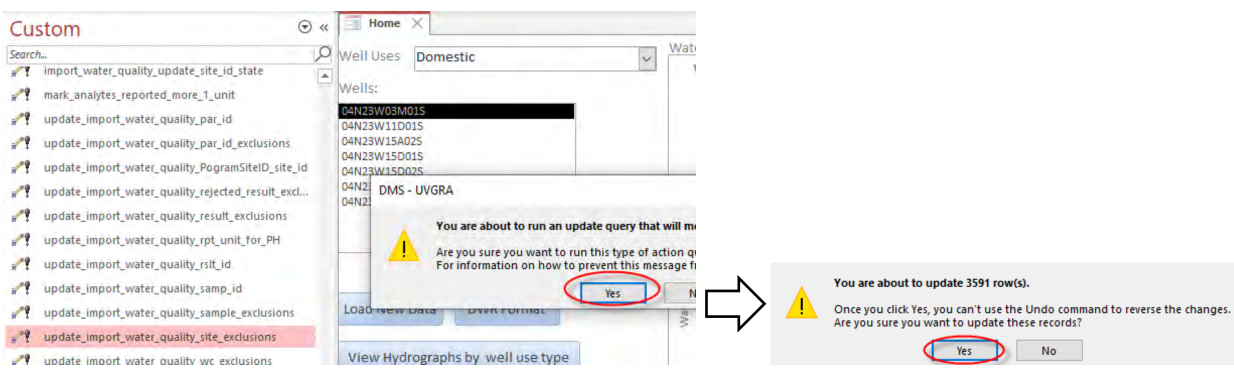


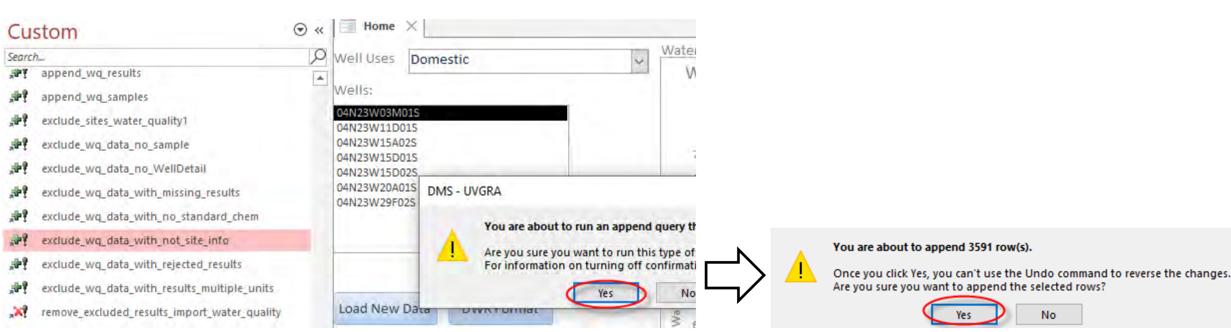
8. Run the following queries in the order shown:
   import_water_quality_update_site_id
   → import_water_quality_update_site_id_state
   → update_import_water_quality_site_exclusions
   → exclude_wq_data_with_not_site_info

   This marks the records in the "import_water_quality" table for which neither Local Well Name nor SWN exists in the "dt_sites" table and adds those records to the "Exclusions_import_water_quality" table.









9. Similar to Step 8, run the following queries in the order shown:
update_site_wc_ids_inimport
→ update_import_water_quality_wc_exclusions
→ exclude_wq_data_no_WellDetail

This marks the records in the "import_water_quality" table for which neither Local Well Name nor SWN exists in the "dt_well_details" table and adds those records to the "Exclusions_import_water_quality" table.

10. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_par_id
→ update_import_water_quality_par_id_exclusions
→ exclude_wq_data_with_no_standard_chem

This marks the records in the "import_water_quality" table for which the CHEMICAL does not exist in the "lu_parameters" table and adds those records to the "Exclusions_import_water_quality" table.

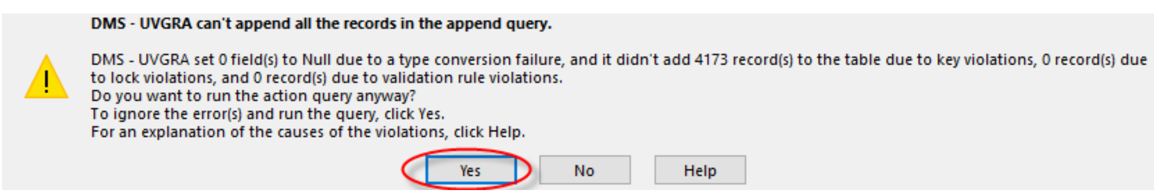
11. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_rejected_result_exclusions
→ exclude_wq_data_with_rejected_results

This marks the records in the "import_water_quality" table for which the Review_Result is Rejected and adds those records to the "Exclusions_import_water_quality" table.

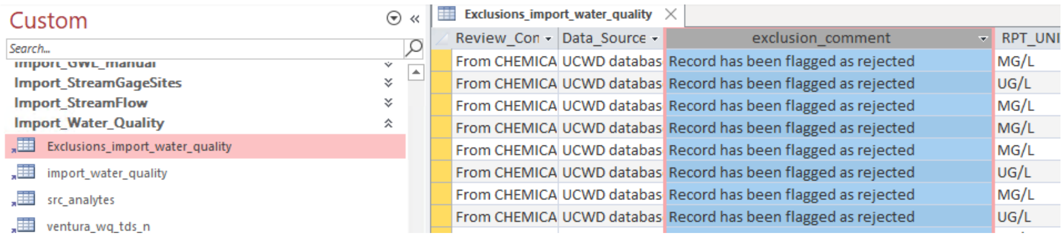
12. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_samp_id
→ append_wq_samples
→ update_import_water_quality_samp_id
→ update_import_water_quality_sample_exclusions
→ exclude_wq_data_no_sample

This adds the new acceptable data from the "import_water_quality" table to the master "dt_samples" table.

Note: Click "Yes" if the message below appears while running the queries.



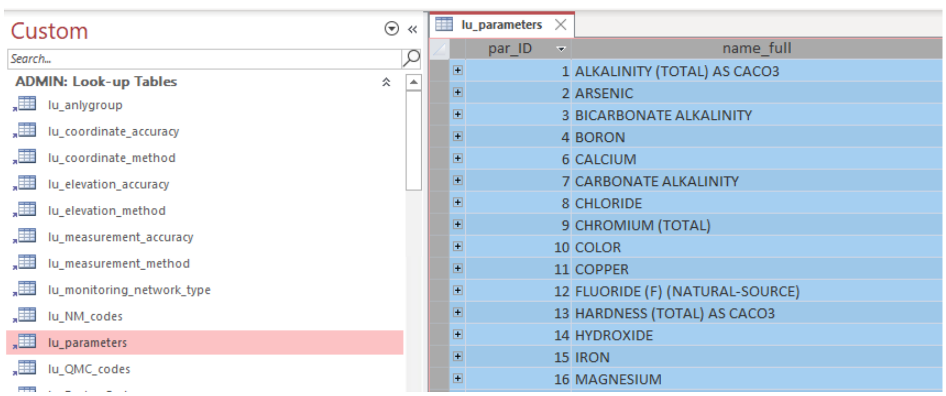
13. Open the “Exclusions_import_water_quality” table to see which new data were not added to the master “dt_samples” table and check the exclusion_comment.



If any field in the water quality data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 12.

If the well information does not exist in the “dt_sites” or “dt_well_details” table, then follow the steps for “Importing Well Data.”

If the chemical information does not exist in the “lu_parameters” table, then update the “lu_parameters” table accordingly. If the chemical information exists in the “lu_anlygroup” table, then run the “update_lu_parameter_anlygroup_from_lu_anlygroup” query to copy that information to the “lu_parameters” table.



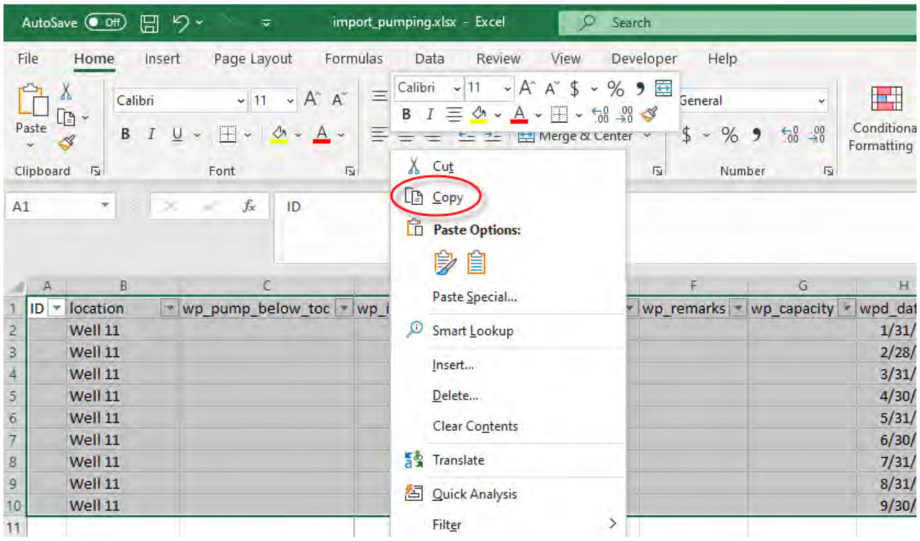
14. Similar to Step 12, run the following queries in the order shown:
update_import_water_quality_result_exclusions
→ update_import_water_quality_rslt_id
→ append_wq_results
→ update_import_water_quality_rslt_id

This adds the new acceptable data from the “import_water_quality” table to the master “dt_results” table.

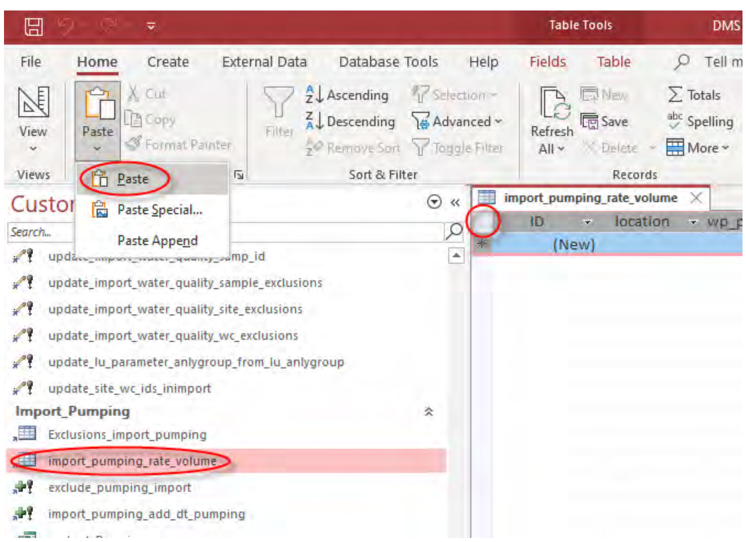
15. Run the “check_import_water_quality_results_not_loaded” query to see which new data were not added to the master “dt_results” table.

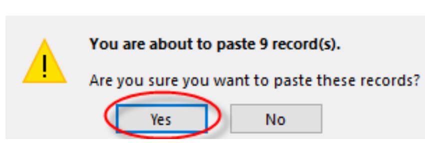
Importing Pumping Data

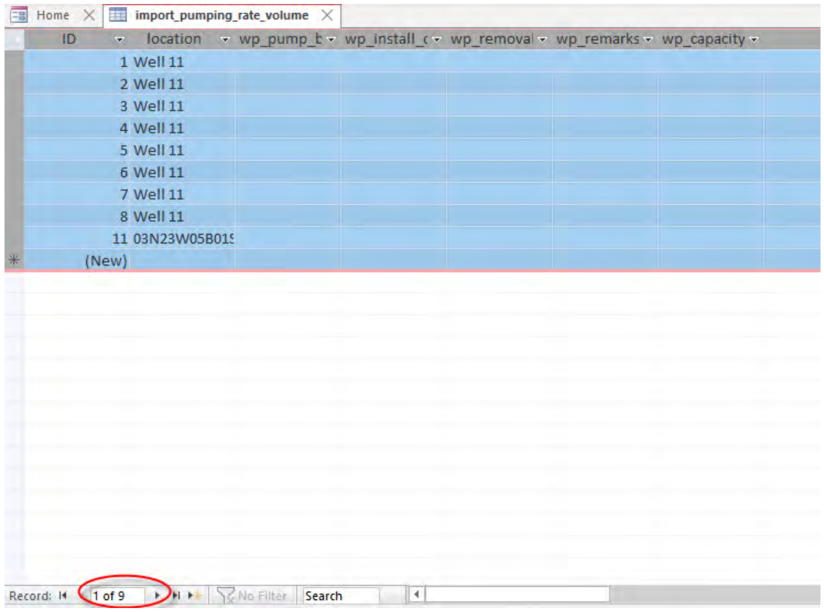
1. Format the data in Excel according to the "import_pumping.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



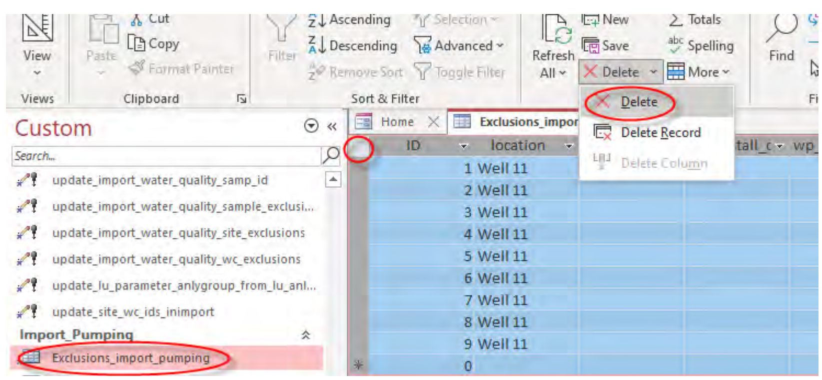
2. Import to DMS by opening the "import_pumping_rate_volume" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_pumping_rate_volume" table is equal to the number of rows copied from Excel.



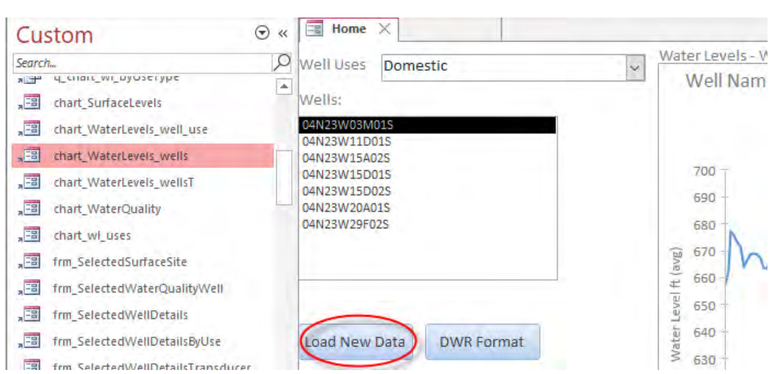


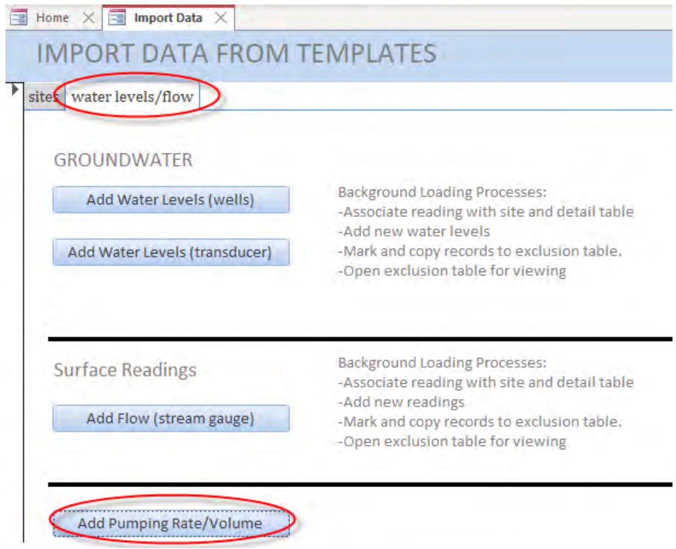


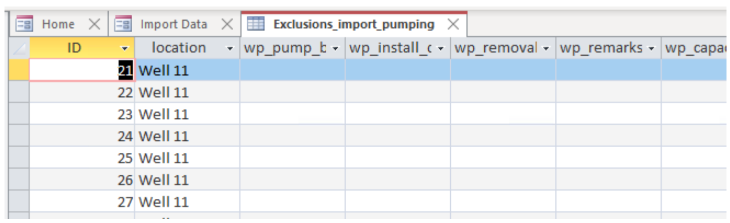
3. Open the "Exclusions_import_pumping" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Pumping Rate/Volume" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_pumping_rate_volume" table to the master "dt_pumping" table and opens the "Exclusions_import_pumping" table to show which new data were not added to the master table due to missing information.







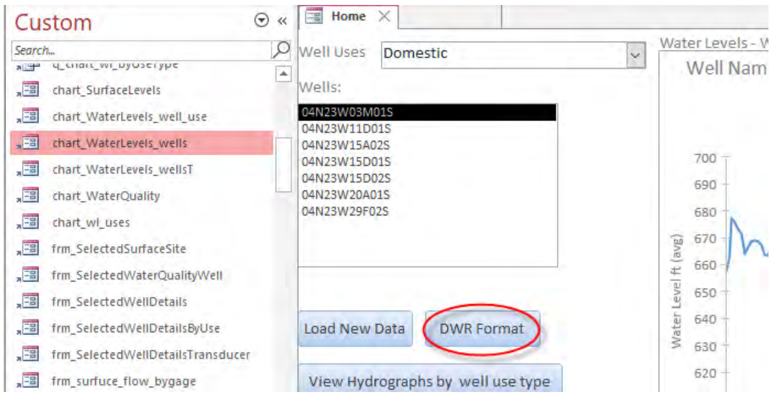
5. For the new data that were not added to the master "dt_pumping" table (i.e., records showing up in the "Exclusions_import_pumping" table), check the location and make sure that it exists in the "dt_sites" and "dt_well_details" tables.

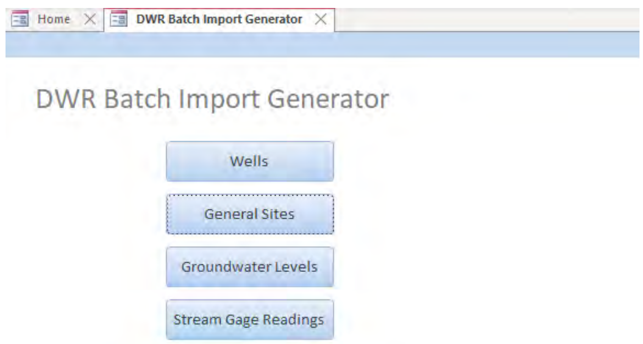
   If the location or any field in the pumping data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

Exporting to DWR Templates

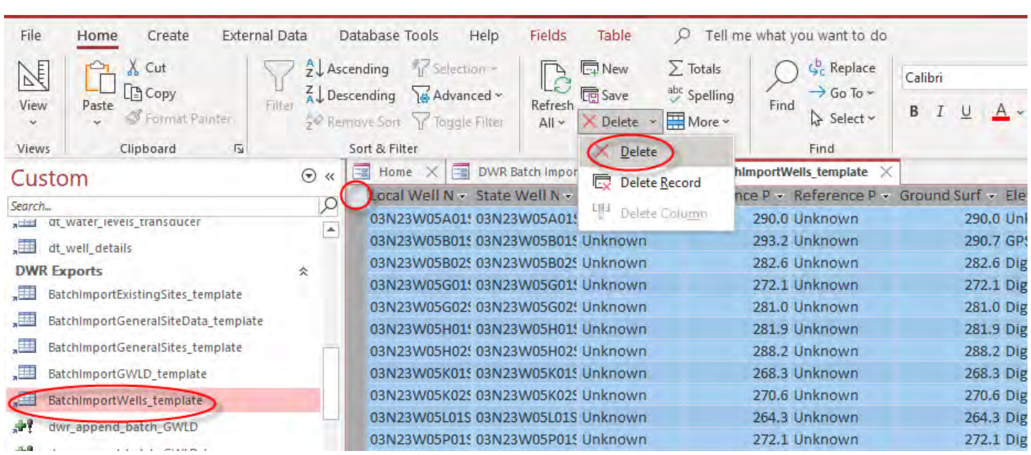
1. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "DWR Format" button. This opens the "DWR Batch Import Generator" form.





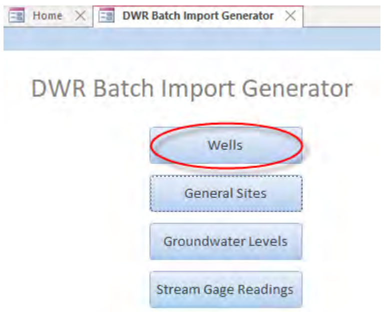
2. For the well template, open the "BatchImportWells_template" table.
   For the general site template, open the "BatchImportGeneralSites_template" table.
   For the groundwater level template, open the "BatchImportGWLD_template" table.
   For the stream gage reading template, open the "BatchImportGeneralSiteData_template" table.

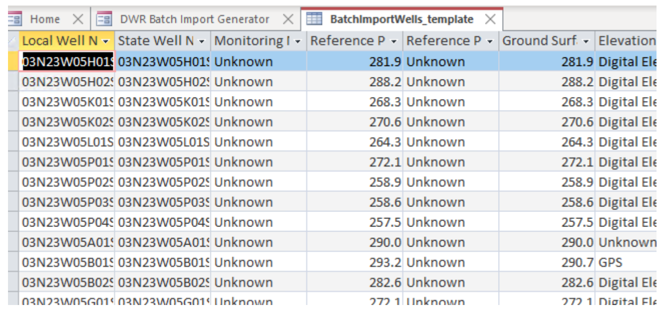
   If the table is not empty, then delete all records in it. After making sure that it is empty, close the table and go back to the "DWR Batch Import Generator" form.



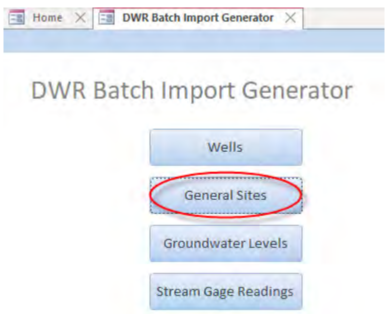
3. For the well template, click the "Wells" button.
For the general site template, click the "General Sites" button.
For the groundwater level template, click the "Groundwater Levels" button.
For the stream gage reading template, click the "Stream Gage Readings" button.

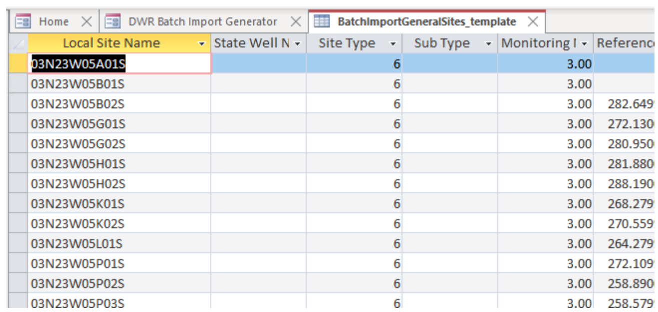
Click "Yes" to confirm. This fills the corresponding template table emptied in Step 2. The data from the template table may be copied and pasted to Excel.



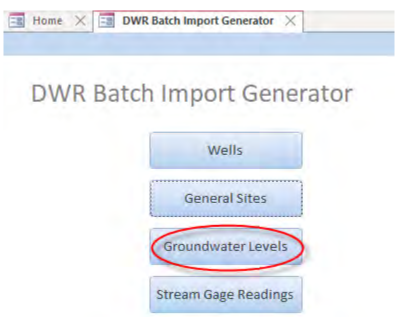


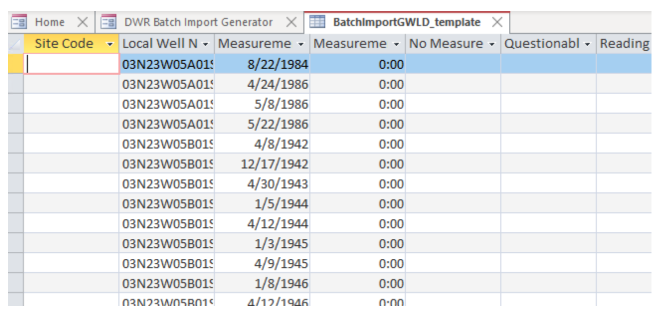
Local Well N	State Well N	Monitoring I	Reference P	Reference P	Ground Surf	Elevation
03N23W05H01S	03N23W05H01S	Unknown	281.9	Unknown	281.9	Digital Ele
03N23W05H02S	03N23W05H02S	Unknown	288.2	Unknown	288.2	Digital Ele
03N23W05K01S	03N23W05K01S	Unknown	268.3	Unknown	268.3	Digital Ele
03N23W05K02S	03N23W05K02S	Unknown	270.6	Unknown	270.6	Digital Ele
03N23W05L01S	03N23W05L01S	Unknown	264.3	Unknown	264.3	Digital Ele
03N23W05P01S	03N23W05P01S	Unknown	272.1	Unknown	272.1	Digital Ele
03N23W05P02S	03N23W05P02S	Unknown	258.9	Unknown	258.9	Digital Ele
03N23W05P03S	03N23W05P03S	Unknown	258.6	Unknown	258.6	Digital Ele
03N23W05P04S	03N23W05P04S	Unknown	257.5	Unknown	257.5	Digital Ele
03N23W05A01S	03N23W05A01S	Unknown	290.0	Unknown	290.0	Unknown
03N23W05B01S	03N23W05B01S	Unknown	293.2	Unknown	290.7	GPS
03N23W05B02S	03N23W05B02S	Unknown	282.6	Unknown	282.6	Digital Ele



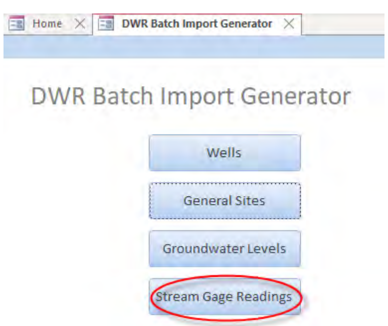


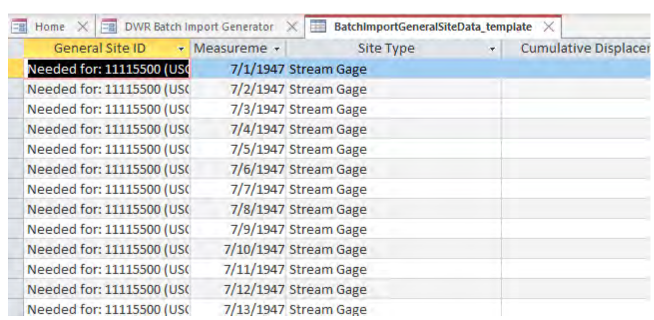
Local Site Name	State Well N	Site Type	Sub Type	Monitoring I	Referenc
03N23W05A01S		6		3.00	
03N23W05B01S		6		3.00	
03N23W05B02S		6		3.00	282.649
03N23W05G01S		6		3.00	272.130
03N23W05G02S		6		3.00	280.950
03N23W05H01S		6		3.00	281.880
03N23W05H02S		6		3.00	288.190
03N23W05K01S		6		3.00	268.279
03N23W05K02S		6		3.00	270.559
03N23W05L01S		6		3.00	264.279
03N23W05P01S		6		3.00	272.109
03N23W05P02S		6		3.00	258.890
03N23W05P03S		6		3.00	258.579





Site Code	Local Well N	Measureme	Measureme	No Measure	Questionabl	Reading
	03N23W05A01S	8/22/1984	0:00			
	03N23W05A01S	4/24/1986	0:00			
	03N23W05A01S	5/8/1986	0:00			
	03N23W05A01S	5/22/1986	0:00			
	03N23W05B01S	4/8/1942	0:00			
	03N23W05B01S	12/17/1942	0:00			
	03N23W05B01S	4/30/1943	0:00			
	03N23W05B01S	1/5/1944	0:00			
	03N23W05B01S	4/12/1944	0:00			
	03N23W05B01S	1/3/1945	0:00			
	03N23W05B01S	4/9/1945	0:00			
	03N23W05B01S	1/8/1946	0:00			

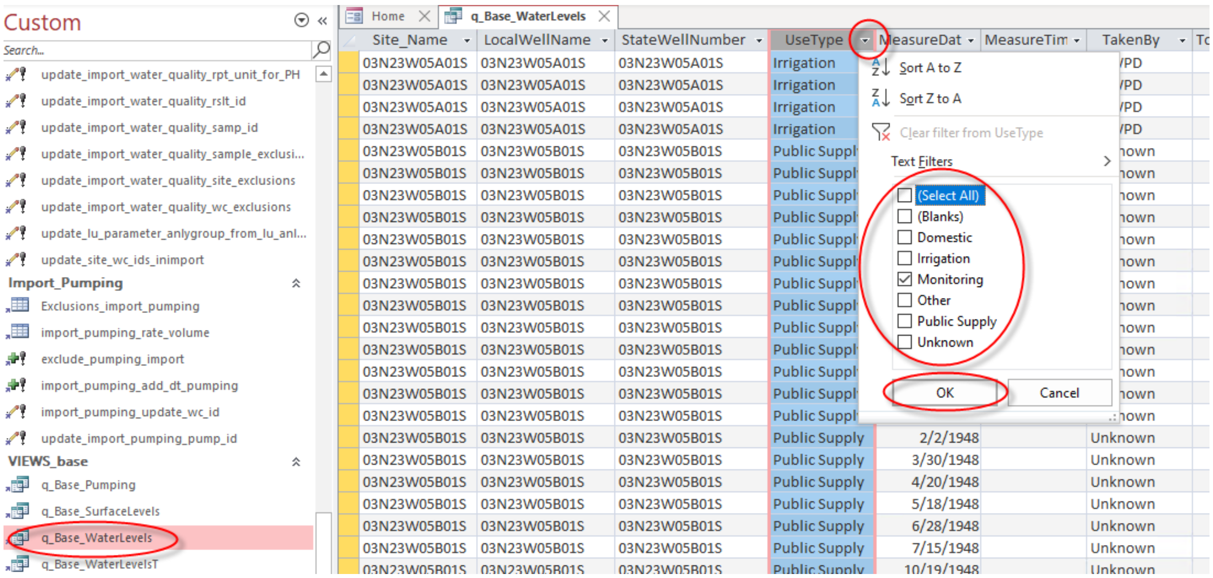


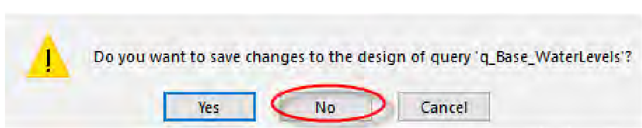


General Site ID	Measureme	Site Type	Cumulative Displacer
Needed for: 11115500 (USC	7/1/1947	Stream Gage	
Needed for: 11115500 (USC	7/2/1947	Stream Gage	
Needed for: 11115500 (USC	7/3/1947	Stream Gage	
Needed for: 11115500 (USC	7/4/1947	Stream Gage	
Needed for: 11115500 (USC	7/5/1947	Stream Gage	
Needed for: 11115500 (USC	7/6/1947	Stream Gage	
Needed for: 11115500 (USC	7/7/1947	Stream Gage	
Needed for: 11115500 (USC	7/8/1947	Stream Gage	
Needed for: 11115500 (USC	7/9/1947	Stream Gage	
Needed for: 11115500 (USC	7/10/1947	Stream Gage	
Needed for: 11115500 (USC	7/11/1947	Stream Gage	
Needed for: 11115500 (USC	7/12/1947	Stream Gage	
Needed for: 11115500 (USC	7/13/1947	Stream Gage	

Viewing the Data Tables

1. The queries under the "VIEWS_base" group can be used to view the data saved in the production data tables. Open the query of interest and click the arrow next to the field name to see the drop-down list. The data can be filtered by checking/unchecking boxes in the drop-down list and clicking "OK." When closing the query, click "No" so that the filter criteria are not saved.





DMS OBJECT DESCRIPTION

Group	Object Name	Object Type	Description
ADMIN: Look-up Tables	lu_anlygroup	Table	Reference table.
	lu_coordinate_accuracy	Table	Reference table.
	lu_coordinate_method	Table	Reference table.
	lu_elevation_accuracy	Table	Reference table.
	lu_elevation_method	Table	Reference table.
	lu_measurement_accuracy	Table	Reference table.
	lu_measurement_method	Table	Reference table.
	lu_monitoring_network_type	Table	Reference table.
	lu_NM_codes	Table	Reference table.
	lu_parameters	Table	Reference table.
	lu_QMC_codes	Table	Reference table.
	lu_ReviewCodes	Table	Reference table.
	lu_SG_codes	Table	Reference table.
	lu_site_type	Table	Reference table.
	lu_well_completion_type	Table	Reference table.
	lu_well_status	Table	Reference table.
	lu_well_type	Table	Reference table.
	lu_well_use_type	Table	Reference table.
	map_well_status	Table	Reference table.
	map_well_use	Table	Reference table.
DMS Data Tables	dt_pumping	Table	Table for storing the pumping data.
	dt_results	Table	Table for storing the water quality results.
	dt_samples	Table	Table for storing the water quality sample data.
	dt_site_details	Table	Table for storing the gage site details.
	dt_site_levels	Table	Table for storing the streamflow data from gages.
	dt_sites	Table	Table for storing the well/gage site info.
	dt_sources	Table	Table for storing the source info.
	dt_water_levels	Table	Table for storing the water level data from wells.
	dt_water_levels_transducer	Table	Table for storing the water level data from transducers.
	dt_well_details	Table	Table for storing the well site details.
DWR Exports	BatchImportGeneralSiteData_template	Table	Table for exporting the streamflow data in DWR format.
	BatchImportGeneralSites_template	Table	Table for exporting the general well/gage site info in DWR format.
	BatchImportGWLD_template	Table	Table for exporting the water level data in DWR format.
	BatchImportWells_template	Table	Table for exporting the well site info in DWR format.
	dwr_append_batch_GWLD	Append Query	Formats the water level data from the "dt_water_levels" table and adds them to the "BatchImportGWLD_template" table.
	dwr_append_batch_GWLD_loggers	Append Query	Formats the water level data from the "dt_water_levels_transducer" table and adds them to the "BatchImportGWLD_template" table.
	dwr_append_batchGeneralSitesGages	Append Query	Formats the gage site info from the "dt_sites" and "dt_site_details" tables and adds it to the "BatchImportGeneralSites_template" table.
	dwr_append_batchGeneralSitesWells	Append Query	Formats the well site info from the "dt_sites" and "dt_well_details" tables and adds it to the "BatchImportGeneralSites_template" table.
	dwr_append_batchGenSitesData_gage	Append Query	Formats the streamflow data from the "dt_site_levels" table and adds them to the "BatchImportGeneralSiteData_template" table.
	dwr_append_batchWells	Append Query	Formats the well site info from the "vDWR_wells" query and adds it to the "BatchImportWells_template" table.
	vDWR_wells	Select Query	Extracts the well site info from the "dt_sites" and "dt_well_details" tables if SiteType = 6. Used as an intermediate step for the "dwr_append_batchWells" query.
	vTopBot_screens	Select Query	Extracts the screening info from the "dt_well_details" table. Used as an intermediate step for the "dwr_append_batchGeneralSitesWells" query.
Import_Wells	Exclusions_ import_wells	Table	Table for viewing the records from the "import_wells" table that have not been loaded to the "dt_sites" or "dt_well_details" table.
	import_wells	Table	Table for importing the well site info.

Group	Object Name	Object Type	Description
	exclude_sites_import_wells	Append Query	Adds the records from the "import_wells" table to the "Exclusions_ import_wells" table if the required well site info (e.g., latitude/longitude, coordinates method/accuracy, county) is missing.
	exclude_wc_import_wells	Append Query	Adds the records from the "import_wells" table to the "Exclusions_ import_wells" table if the required well site details are missing.
	import_wells_add_dt_sites	Append Query	Formats the well site info from the "import_wells" table and adds it to the "dt_sites" table. Does not add if a record with the same Local Well Name/State Well Number already exists in the "dt_sites" table.
	import_wells_add_dt_well_details	Append Query	Formats the well site details from the "import_wells" table and adds them to the "dt_well_details" table. Does not add if a record with the same Local Well Name/State Well Number already exists in the "dt_well_details" table.
	import_wells_update_site_id	Update Query	Adds site_id to the records in the "import_wells" table if the matching Local Well Name is found in the "dt_sites" table.
	import_wells_update_site_id_state	Update Query	Adds site_id to the records in the "import_wells" table if the matching State Well Number is found in the "dt_sites" table.
	import_wells_update_wc_id	Update Query	Adds wc_id to the records in the "import_wells" table if the matching site_id is found in the "dt_well_details" table.
Import_GWL_logger	Exclusions_import_gwl_logger	Table	Table for viewing the records from the "import_gwl_logger" table that have not been loaded to the "dt_water_levels_transducer" table.
	import_gwl_logger	Table	Table for importing the water level data from transducers.
	exclude_wlt_import_gwllogger	Append Query	Adds the records from the "import_gwl_logger" table to the "Exclusions_import_gwl_logger" table if the required well site info is missing.
	import_gwlt_add_dt_water_level_trans	Append Query	Formats the water level data from the "import_gwl_logger" table and adds them to the "dt_water_levels_transducer" table. Does not add if a record with the same Local Well Name/Site Code and Measurement Date/Time already exists in the "dt_water_levels_transducer" table.
	import_gwlt_update_site_id_wc_id_localname	Update Query	Adds site_id and wc_id to the records in the "import_gwl_logger" table if the matching Local Well Name is found in the "dt_sites" table.
	import_gwlt_update_site_id_wc_id_sitecode	Update Query	Adds site_id and wc_id to the records in the "import_gwl_logger" table if the matching Site Code is found in the "dt_sites" table.
	import_gwlt_update_wlt_id	Update Query	Adds wlt_id to the records in the "import_gwl_logger" table if the matching wc_id and Measurement Date/Time are found in the "dt_water_levels_transducer" table.
	update_display_rejected_water_levels_logger	Update Query	Sets use_flag = 0 in the "dt_water_levels_transducer" table if Review_Result = "Rejected."
Import_GWL_manual	Exclusions_import_gwl_manual	Table	Table for viewing the records from the "import_gwl_manual" table that have not been loaded to the "dt_water_levels" table.
	import_gwl_manual	Table	Table for importing the water level data from wells.
	exclude_wlm_import_gwlman	Append Query	Adds the records from the "import_gwl_manual" table to the "Exclusions_import_gwl_manual" table if the required well site info is missing.
	import_gwlman_add_dt_water_levels	Append Query	Formats the water level data from the "import_gwl_manual" table and adds them to the "dt_water_levels" table. Does not add if a record with the same Local Well Name and Measurement Date already exists in the "dt_water_levels" table.
	import_wlman_tomatch	Select Query	Formats Measurement Date in the "import_gwl_manual" table. Used as an intermediate step for the "import_gwlman_Update_wlID" query.

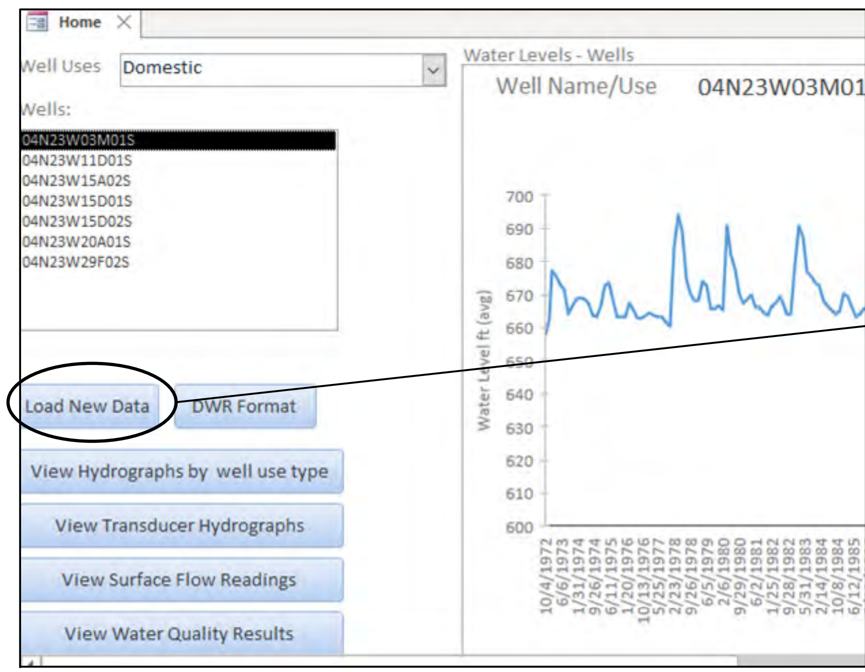
Group	Object Name	Object Type	Description
	import_gwlman_Update_siteID_wcID	Update Query	Adds site_id and wc_id to the records in the "import_gwl_manual" table if the matching Local Well Name is found in the "dt_sites" table.
	import_gwlman_Update_siteID_wcIDStateWell	Update Query	Adds site_id and wc_id to the records in the "import_gwl_manual" table if the matching Local Well Name is found in the "dt_well_details" table.
	import_gwlman_Update_wlID	Update Query	Adds wl_id to the records in the "import_gwl_manual" table if the matching wc_id and Measurement Date are found in the "dt_water_levels" table.
	update_display_rejected_water_levels	Update Query	Sets use_flag = 0 in the "dt_water_levels" table if Review_Result = "Rejected."
Import_StreamGageSites	Exclusions_import_stream_gauge_sites	Table	Table for viewing the records from the "import_stream_gage_sites" table that have not been loaded to the "dt_sites" or "dt_site_details" table.
	import_stream_gauge_sites	Table	Table for importing the gage site info.
	exclude_sd_import_gaugesites	Append Query	Adds the records from the "import_stream_gauge_sites" table to the "Exclusions_import_stream_gauge_sites" table if the required gage site details are missing.
	exclude_sites_import_gaugesites	Append Query	Adds the records from the "import_stream_gauge_sites" table to the "Exclusions_import_stream_gauge_sites" table if the required gage site info (e.g., latitude/longitude, coordinates method/accuracy, county) is missing.
	import_sg_sites_add_dt_site_details	Append Query	Formats the gage site details from the "import_stream_gauge_sites" table and adds them to the "dt_site_details" table. Does not add if a record with the same Local Site Name already exists in the "dt_site_details" table.
	import_sg_sites_add_dt_sites	Append Query	Formats the gage site info from the "import_stream_gauge_sites" table and adds it to the "dt_sites" table. Does not add if a record with the same Local Site Name already exists in the "dt_sites" table.
	import_sg_sites_update_sd_id	Update Query	Adds sd_id to the records in the "import_stream_gauge_sites" table if the matching site_id is found in the "dt_site_details" table.
	import_sg_sites_update_site_id	Update Query	Adds site_id to the records in the "import_stream_gauge_sites" table if the matching Local Site Name is found in the "dt_sites" table.
Import_StreamFlow	Exclusions_import_stream_gauge_flow	Table	Table for viewing the records from the "import_stream_gauge_flow" table that have not been loaded to the "dt_site_levels" table.
	import_stream_gauge_flow	Table	Table for importing the streamflow data from gages.
	exclude_sgflow_import_stream_gauge_flow	Append Query	Adds the records from the "import_stream_gauge_flow" table to the "Exclusions_import_stream_gauge_flow" table if the required gage site info or Surface Water Discharge (cubic feet per second) is missing.
	import_sg_flow_add_dt_site_levels	Append Query	Formats the streamflow data from the "import_stream_gauge_flow" table and adds them to the "dt_site_levels" table. Does not add if a record with the same General Site ID and Measure Date and Time already exists in the "dt_site_levels" table.
	import_sg_flow_date_time	Select Query	Formats Measure Date and Time in the "import_stream_gauge_flow" table. Used as an intermediate step for the "import_sg_flow_update_sl_id" query.
	import_sg_flow_site_id_sd_id	Update Query	Adds site_id and sd_id to the records in the "import_stream_gauge_flow" table if the matching General Site ID is found in the "dt_sites" table.
	import_sg_flow_update_sl_id	Update Query	Adds sl_id to the records in the "import_stream_gauge_flow" table if the matching sd_id and Measure Date and Time are found in the "dt_site_levels" table.
	update_display_rejected_stream_flow	Update Query	Sets use_flag = 0 in the "dt_site_levels" table if Review_Result = "Rejected."
Import_Water_Quality	Exclusions_import_water_quality	Table	Table for viewing the records from the "import_water_quality" table that have not been loaded to the "dt_samples" table.

Group	Object Name	Object Type	Description
	import_water_quality	Table	Contents from the "wq_source_data" table plus Data_Source.
	wq_source_data	Table	Table for importing the water quality data.
	append_IMPORT_to_Staging	Append Query	Adds all records from the "wq_source_data" table to the "import_water_quality" table.
	append_wq_results	Append Query	Formats the water quality data from the "import_water_quality" table and adds them to the "dt_results" table. Does not add if a record with the same Local Well Name/SWN, SAMP DATE, and CHEMISTRY already exists in the "dt_results" table.
	append_wq_samples	Append Query	Formats the water quality data from the "import_water_quality" table and adds them to the "dt_samples" table. Does not add if a record with the same Local Well Name/SWN and SAMP DATE already exists in the "dt_samples" table.
	exclude_wq_data_no_sample	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if the matching wc_id and SAMP DATE are not found in the "dt_samples" table.
	exclude_wq_data_no_WellDetail	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_well_details" table.
	exclude_wq_data_with_no_standard_chem	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if the matching CHEMISTRY is not found in the "lu_parameters" table.
	exclude_wq_data_with_not_site_info	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_sites" table.
	exclude_wq_data_with_rejected_results	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if Review_Result = "Rejected."
	check_each_chem_reported_in_one_unit	Select Query	Shows the unit of each analyte.
	check_import_water_quality_results_not_loaded	Select Query	Shows the records from the "import_water_quality" table that have not been loaded to the "dt_results" table.
	chemicals_results_multiple_units	Select Query	Shows the analytes reported in more than one unit.
	import_water_quality_update_site_id	Update Query	Adds site_id to the records in the "import_water_quality" table if the matching Local Well Name is found in the "dt_sites" table.
	import_water_quality_update_site_id_state	Update Query	Adds site_id to the records in the "import_water_quality" table if the matching SWN is found in the "dt_sites" table.
	update_import_water_quality_par_id	Update Query	Adds par_id to the records in the "import_water_quality" table if the matching CHEMISTRY is found in the "lu_parameters" table.
	update_import_water_quality_par_id_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching CHEMISTRY is not found in the "lu_parameters" table.
	update_import_water_quality_rejected_result_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if Review_Result = "Rejected."
	update_import_water_quality_result_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching samp_id and par_id are not found in the "dt_results" table.
	update_import_water_quality_rpt_unit_for_PH	Update Query	Sets rpt_unit = "S.U." in the "import_water_quality" table if CHEMICAL = "PH, LABORATORY."
	update_import_water_quality_rslt_id	Update Query	Adds rslt_id to the records in the "import_water_quality" table if the matching samp_id and par_id are found in the "dt_results" table.
	update_import_water_quality_samp_id	Update Query	Adds samp_id to the records in the "import_water_quality" table if the matching wc_id and SAMP DATE are found in the "dt_samples" table.
	update_import_water_quality_sample_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching wc_id and SAMP DATE are not found in the "dt_samples" table.

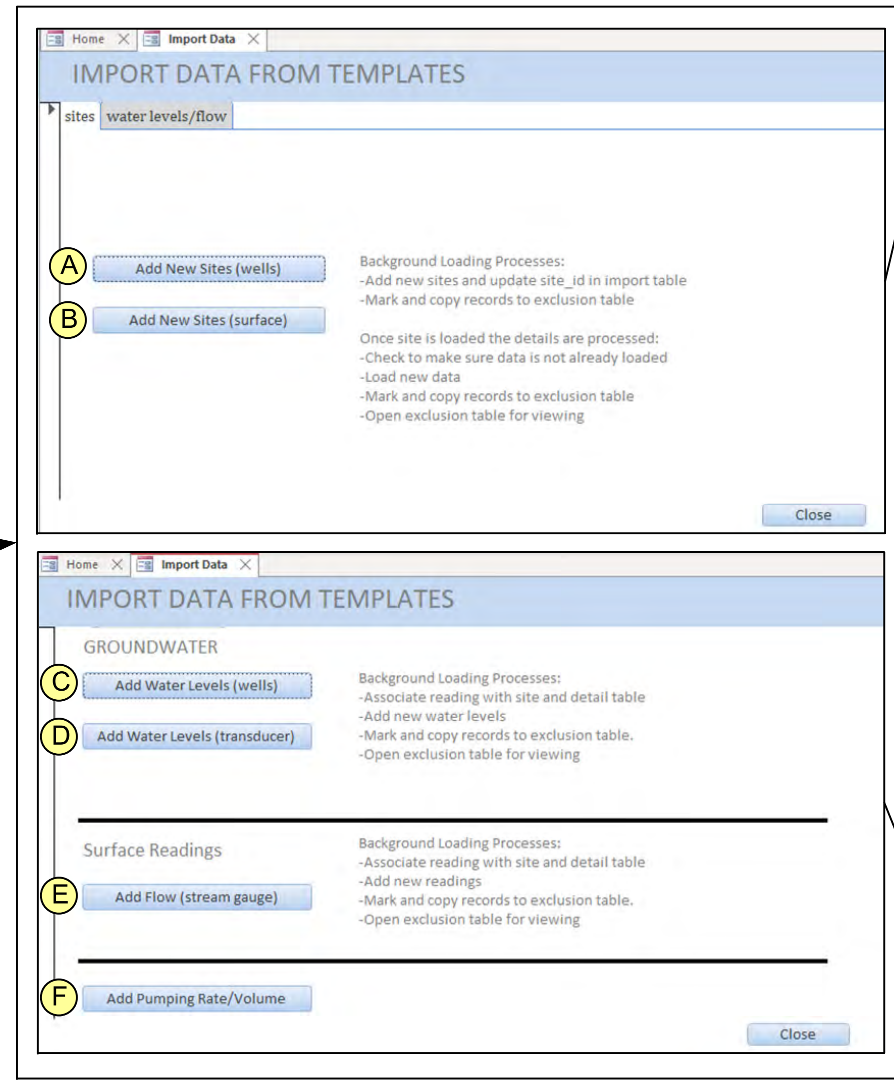
Group	Object Name	Object Type	Description
	update_import_water_quality_site_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_sites" table.
	update_import_water_quality_wc_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_well_details" table.
	update_lu_parameter_anlygroup_from_lu_anlygroup	Update Query	Copies the chemical info from the "lu_anlygroup" table to the "lu_parameters" table.
	update_site_wc_ids_inimport	Update Query	Adds wc_id to the records in the "import_water_quality" table if the matching Local Well Name/SWN is found in the "dt_well_details" table.
Import_GWL_logger	Exclusions_import_pumping	Table	Table for viewing the records from the "import_pumping_rate_volume" table that have not been loaded to the "dt_pumping" table.
	import_pumping_rate_volume	Table	Table for importing the pumping data.
	exclude_pumping_import	Append Query	Adds the records from the "import_pumping_rate_volume" table to the "Exclusions_import_pumping" table if the required well site info is missing.
	import_pumping_add_dt_pumping	Update Query	Formats the pumping data from the "import_pumping_rate_volume" table and adds them to the "dt_pumping" table. Does not add if a record with the same location, wpd_date, wpd_vol, wpd_vol_unit, and wpd_vol_period already exists in the "dt_pumping" table.
	import_pumping_update_wc_id	Update Query	Adds site_id and sd_id to the records in the "import_stream_gauge_flow" table if the matching location is found in the "dt_sites" table.
	update_import_pumping_pump_id	Update Query	Adds pump_id to the records in the "import_pumping_rate_volume" table if the matching wc_id, wpd_date, wpd_vol, wpd_vol_unit, and wpd_vol_period are found in the "dt_pumping" table.
VIEWS_base	q_Base_Pumping	Select Query	Shows the contents of select fields in the "dt_pumping" table.
	q_Base_SurfaceLevels	Select Query	Shows the contents of select fields in the "dt_site_levels" table.
	q_Base_WaterLevels	Select Query	Shows the contents of select fields in the "dt_water_levels" table.
	q_Base_WaterLevelsT	Select Query	Shows the contents of select fields in the "dt_water_levels_transducer" table.
	q_Base_WaterQuality	Select Query	Shows the contents of select fields in the "dt_samples" and "dt_results" tables.

DMS Object Map: Importing Data

“chart_WaterLevels_wells” Form



“frmImportData” Form



(A)

Input Tables:
- import_wells
- lu_monitoring_network_type
- lu_site_type

Queries (run in order shown):
- import_wells_update_site_id
- import_wells_update_site_id_state
- import_wells_add_dt_sites
- import_wells_update_site_id
- import_wells_update_site_id_state
- exclude_sites_import_wells
- import_wells_update_wc_id
- import_wells_add_dt_well_details
- import_wells_update_wc_id
- exclude_wc_import_wells

Output Tables:
- dt_sites
- dt_well_details
- Exclusions_ import_wells

(B)

Input Tables:
- import_stream_gauge_sites
- lu_monitoring_network_type
- lu_site_type

Queries (run in order shown):
- import_sg_sites_update_site_id
- import_sg_sites_add_dt_sites
- import_sg_sites_update_site_id
- exclude_sites_import_gaugesites
- import_sg_sites_update_sd_id
- import_sg_sites_add_dt_site_details
- import_sg_sites_update_sd_id
- exclude_sd_import_gaugesites

Output Tables:
- dt_sites
- dt_site_details
- Exclusions_import_stream _gauge_sites

(C)

Input Tables:
- import_gwl_manual
- dt_sites
- dt_well_details

Queries (run in order shown):
- import_gwlman_Update_siteID_wcID
- import_gwlman_Update_siteID_wcIDState Well
- import_gwlman_Update_wlID
- import_gwlman_add_dt_water_levels
- import_gwlman_Update_wlID
- exclude_wlm_import_gwlman
- update_display_rejected_water_levels

Output Tables:
- dt_water_levels
- Exclusions_import_gwl _manual

(D)

Input Tables:
- import_gwl_logger
- dt_sites
- dt_well_details

Queries (run in order shown):
- import_gwlt_update_site_id_wc_id_localname
- import_gwlt_update_site_id_wc_id_sitecode
- import_gwlt_update_wlt_id
- import_gwlt_add_dt_water_level_trans
- import_gwlt_update_wlt_id
- exclude_wlt_import_gwllogger
- update_display_rejected_water_levels_logger

Output Tables:
- dt_water_levels_transducer
- Exclusions_import_gwl _logger

(E)

Input Tables:
- import_stream_gauge_flow
- dt_sites
- dt_site_details

Queries (run in order shown):
- import_sg_flow_site_id_sd_id
- import_sg_flow_add_dt_site_levels
- import_sg_flow_update_sl_id
- exclude_sgflow_import_stream_gauge_flow
- update_display_rejected_stream_flow

Output Tables:
- dt_site_levels
- Exclusions_import_stream _gauge_flow

(F)

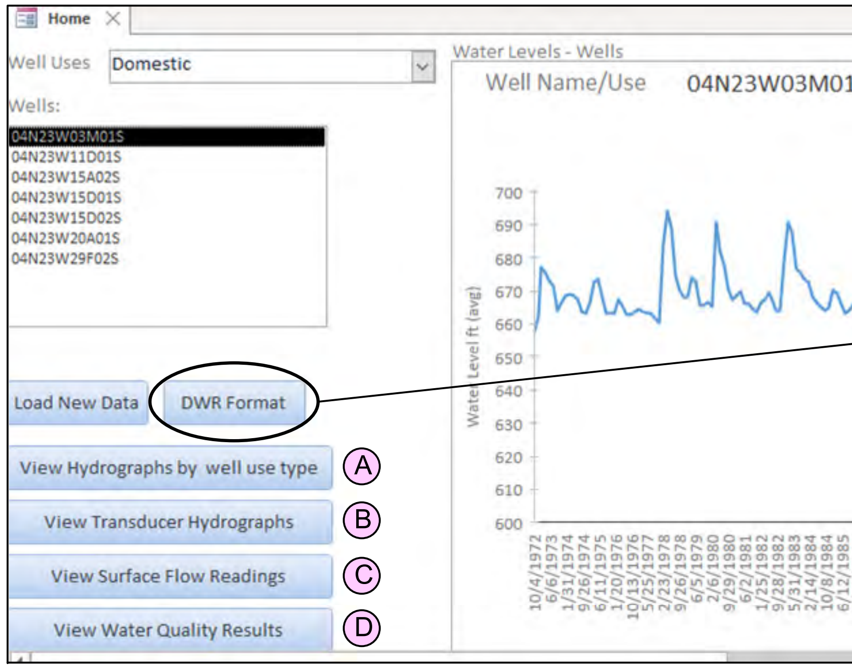
Input Tables:
- import_pumping_rate _volume
- dt_sites
- dt_well_details
- dt_sources

Queries (run in order shown):
- import_pumping_update_wc_id
- update_import_pumping_pump_id
- import_pumping_add_dt_pumping
- update_import_pumping_pump_id
- exclude_pumping_import

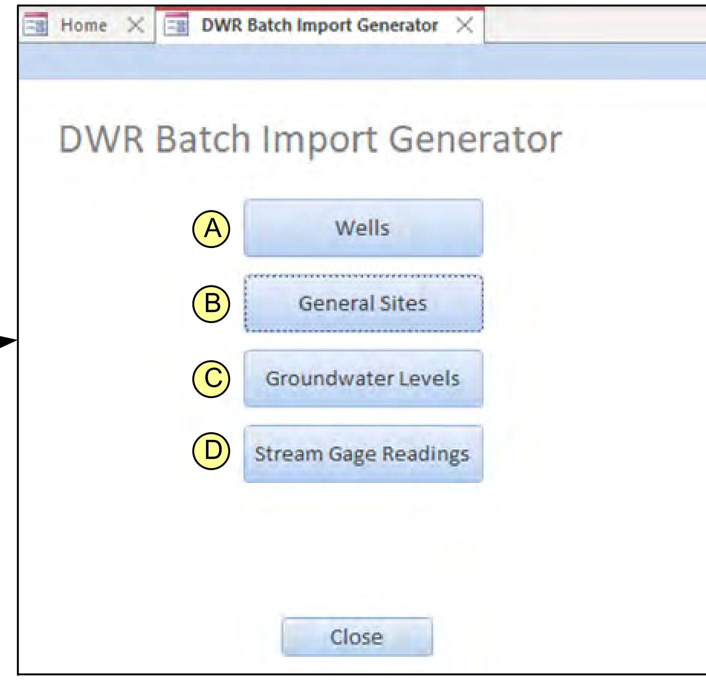
Output Tables:
- dt_pumping
- Exclusions_import_pumping

DMS Object Map: Formatting Data & Graphing

“chart_WaterLevels_wells” Form



“frmDWR_Exports” Form



Ⓐ
Input Tables:
- dt_sites
- dt_well_details
- lu_monitoring_network_type

Queries (run in order shown):
- dwr_append_batchWells

Output Tables:
- BatchImportWells_template

Ⓑ
Input Tables:
- dt_sites
- dt_site_details
- dt_well_details

Queries (run in order shown):
- dwr_append_batchGeneralSitesGages
- dwr_append_batchGeneralSitesWells

Output Tables:
- BatchImportGeneralSites_template

Ⓒ
Input Tables:
- dt_sites
- dt_well_details
- dt_water_levels
- dt_water_levels_transducer

Queries (run in order shown):
- dwr_append_batch_GWLD
- dwr_append_batch_GWLD_loggers

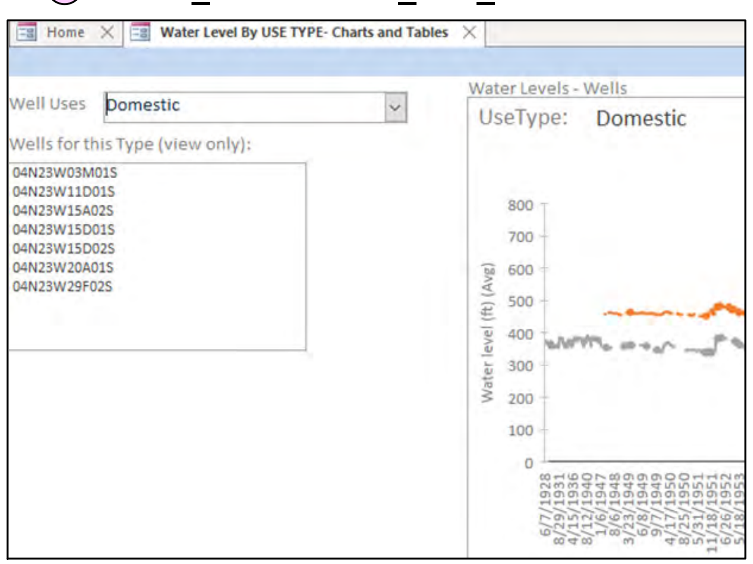
Output Tables:
- BatchImportGWLD_template

Ⓓ
Input Tables:
- dt_sites
- dt_site_details
- dt_site_levels
- lu_site_type

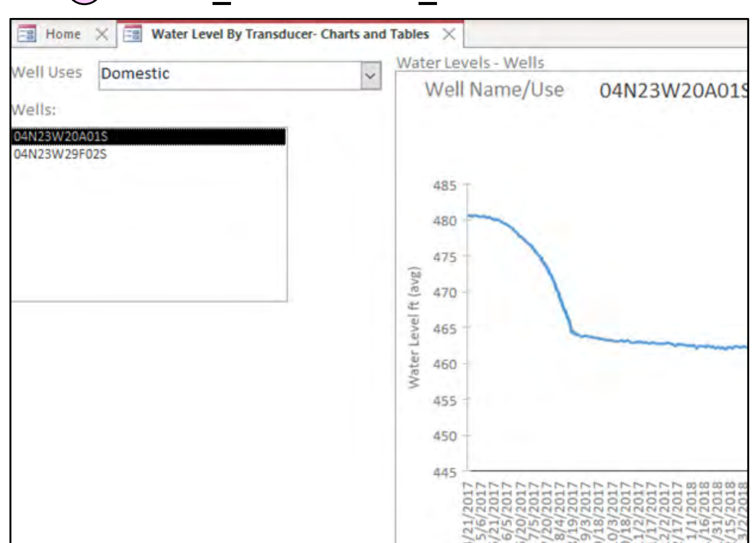
Queries (run in order shown):
- dwr_append_batchGenSitesData_gage

Output Tables:
- BatchImportGeneralSiteData_template

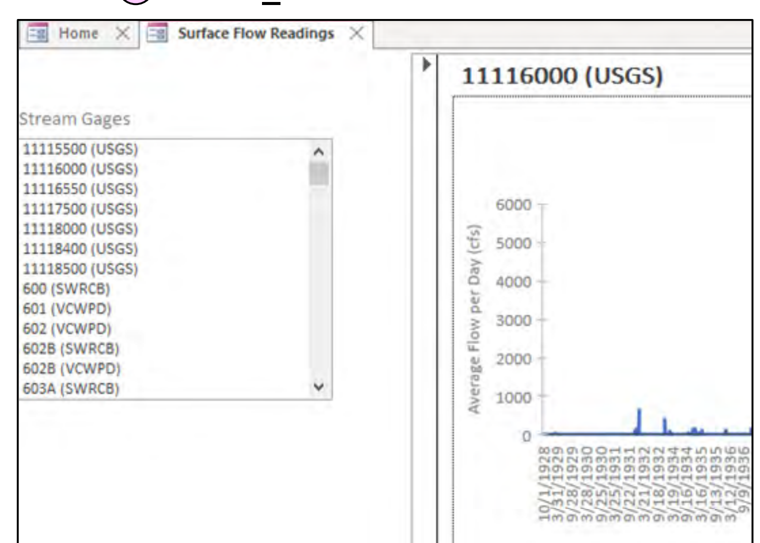
Ⓐ **“chart_WaterLevels_well_use” Form**



Ⓑ **“chart_WaterLevels_wellsT” Form**



Ⓒ **“chart_SurfaceLevels” Form**



Ⓓ **“chart_WaterQuality” Form**